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ABSTRACT

A set of short tests aimed at measuring student mastery of specific skills in the natural sciences are presented with a description of the mastery program's purposes, development, and methods. Mastery learning, criterion-referenced testing, and the scope of skills to be tested are defined. Each of the multiple choice tests for grades 7 through 10 are aimed at a single skill. A test construction guide and instructions for administering the tests are included with a list of the tests available in the program. Among the skills tested are identification, comprehension of tables and graphs, measurements, and calculations. The appendices include answer keys, a sample answer sheet, and inspection copies of 26 tests with scope notes and scoring information. (CM)

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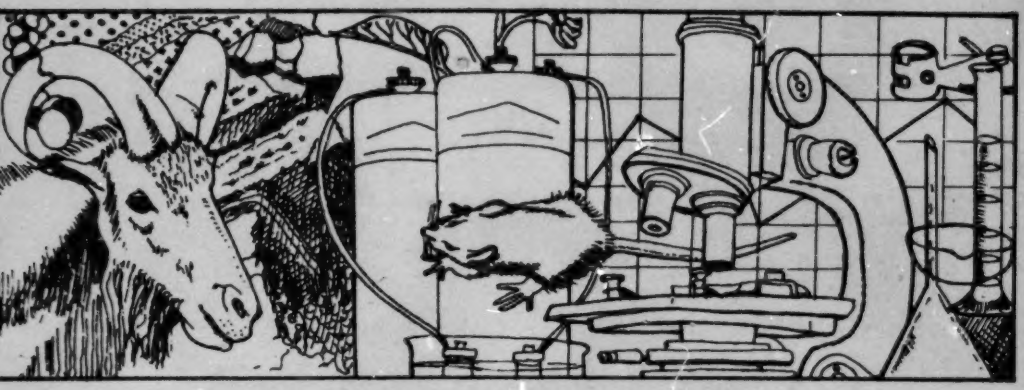
SCIENCE

MASTERY TESTING PROGRAMME



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INTRODUCTION AND MANUAL

Volume Three

ACKNOWLEDGEMENTS

The mastery test programme was conceived by Peter Macinnis and John Turner in the School Certificate Development Unit.

The formats were developed by Peter Macinnis on the basis of advice given by Glen Coulton, Ian Munro and Paul Steenson of the School Certificate Development Unit.

Chris Angus of Granville South High School suggested some of the topics, wrote some of the tests and reviewed other tests.

Kim Fillingham of Killara High School reviewed some of the tests written by others and helped with final revisions.

Brian Jarman of Turramurra High School reviewed some of the tests written by others and helped with final revisions.

Peter Macinnis of the School Certificate Development Unit suggested some of the topics, wrote some of the tests and reviewed other tests.

Greg Meyer of Granville South High School suggested some of the topics, wrote some of the tests and reviewed other tests.

Kevin Molyneux of Cabramatta High School helped to develop the range of topics which the tests could cover, suggested some of the topics, wrote a number of tests, reviewed some of the tests written by others, and helped with the final revisions.

Gaye Rosen, formerly of Fort Street High School, now at the School of Education, U.N.S.W. helped to define the purpose of the tests, helped to develop the range of topics, which the tests could cover, suggested some of the topics, wrote a number of tests, reviewed some of the tests written by others, and helped with the final revisions.

Brian Shadwick of Riverside Girls' High School has been the main writer of mastery tests. Without his work to convert the theories of others to practical classroom tests, the project could well have foundered. He was involved also in reviewing tests written by others, and in the final revisions.

Due credit must also be given to the School Certificate Development Unit typists, Sharon Webb, Alison Adlard and Margaret Ford who typed the tests, and to Jan Anglim, Bronwyn Mondel and Ester Kasepuu who drew the diagrams.

Finally, the efforts of more than a hundred teachers who used the tests in trial form and supplied feedback to the School Certificate Development Unit must be recognised.

FOREWORD

A mastery test is a short test aimed at measuring a student's mastery of a specified skill. This is done most conveniently by setting a number of similar multiple-choice items, and this is the sort of mastery test shown here. This Manual shows the range of tests currently available, and explains something of the educational thinking which underlies their development.

MULTIPLE ERRATUM

At a late stage of preparation for printing, it was found that the *pro forma* for page 4 of the tests contained a typographical error. The reference to "longest samples" in the line above the table should be to "largest samples". This will be corrected on the tests when they are released.

"I keep six honest serving-men
(They taught me all I knew);
Their names are What and Why and When,
And How and Where and Who".

- Rudyard Kipling : "The Elephant's Child"

These questions are answered in the section indicated:

		SECTION	PAGE
WHAT			
	is a mastery test?	1	1
	is mastery learning?	2	1
	is a criterion-referenced test?	3	3
	does a mastery test measure?	6	5
	is a skill?	6	5
	is available?	7	7
	will be available?	7	7
	should be done with "failures"?	8	11
	is a mastery "pass"?	10	11
	are the limitations of the statistics?	10	11
	are the limitations of the tests?	11	12
	should mastery tests be used for?	11	12
	effect will they have on the curriculum?	12	12
WHY			
	have mastery tests?	1	1
WHEN			
	should mastery tests be used?	8	11
	should mastery tests not be used?	11	12
HOW			
	can the marks be added? (they shouldn't)	3	3
	should marks be recorded and reported?	4	3
	are the tests developed?	5	4
	long should students be allowed?	9	11
	should scores be interpreted?	10	11
	should skills and tests be selected?	12	12
	can teachers write their own mastery tests?	14	13
WHERE			
	should "masters" be placed?	10	11
	should "non-masters" be placed?	10	11
	does mastery testing fit into a school testing programme?	11	
	should tests be run?	13	12
	should results be recorded?	13	12
WHO			
	can be ranked by mastery tests? (No-one!)	4	3
	is to be called a "master"?	10	11
	should choose which tests should be done?	12	12
	should choose when tests will be done?	13	12

This manual is intended to supply all the information a teacher may need about the mastery testing programme. As such, it is likely that most teachers will find some parts of the supplied information to be superfluous. To save time for users, the manual is laid out in question and answer form. Where teachers feel that they know the answer, they will be able to skip-read to the next question.

1. What is the mastery testing programme?

The mastery testing programme involves the development of mastery tests for use in Years 7 to 10 in N.S.W. science classes. Each test is aimed at a single *skill*, and consists of 10, 15 or 20 multiple choice questions. These appear on the inside opposite pages of a four-page folded sheet. The tests are designed to establish whether or not a student has mastered a particular skill (using Bloom's sense of mastery learning). The scores are looked at from a *criterion-referenced* viewpoint, not a norm-referenced viewpoint. The tests should be used by teachers who have adopted a mastery learning strategy in their classes.

2. What is mastery learning?

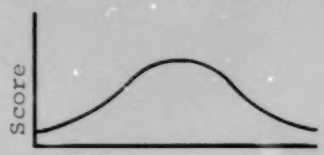
"Mastery learning", a term generally attributed to Bloom (1) connotes a teaching method which assumes that if teaching is tailored to the student, a large majority of students can master a given skill. In essence, it claims that learning is sequential, and that the reason most failures occur on any given skill is that the teachers did not check that students had the necessary pre-requisite skills before teaching that skill. Mastery teachers analyse a course into small bits, often of a week's teaching or less, and test for mastery at the end of each bit. Those who do not achieve mastery at the first test are given immediate help, and opportunities to retake the test. Only when this *bit* has been mastered is the *next* bit begun.

This approach arose from the work of John B. Carroll (3) who found that aptitude for learning foreign languages was more closely correlated with the time required to reach a given level in a language learning task than with any other variable. In other words, the greater your aptitude, the sooner you reach a "pass" mark.

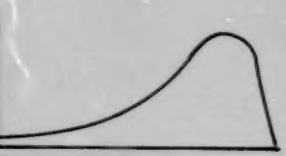
The "mastery school" go on from here to argue that aptitude is distributed normally in any random sample of students. It is not surprising, they suggest, that class scores on achievement tests tend to be normally distributed, for the only variable they reflect is aptitude. Teacher, time and method are usually the same for all students in a class; only aptitude varies, and it is normally distributed.

The ultimate claim for the mastery teaching strategy is made Bloom who says that even aptitude can be equalised for most udents. (He really means "most" - 95% is his estimate!) He bases is claim on two observations. The first is that when the mastery aching strategy is conscientiously followed, those with low initial titude, that is those who initially need the most time to reach stery, show a steady decrease in the time needed to reach mastery succeeding skills as the course progresses. The second is that ereas the pre-test/post-test correlation for students taught in the rmal way is very high, it tends to zero when the mastery strategy followed. That is, there is no way of telling from the end-of-course ores who were the slow students when the course began.

When you need to make a summative evaluation of student achievent, possibly for the purpose of assigning end-of-course grades, you ll maximise the reliability of your assessment if your measuring struments produce a normal distribution, (or what is even preferable, symmetric distribution that is flatter than normal.



The mastery strategy, on the other hand, expects that most udents will attain mastery of each skill, and mastery tests are liberately designed to detect if this has occurred. If it has, then e distribution will display a "ceiling" (usually 100%) above which en the best students cannot score, and a small band just below the iling within which most scores will lie. Hence mastery test score stributions should look more like this:



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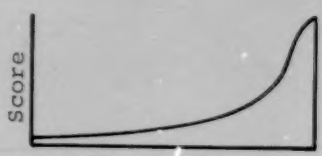


ose who are not familiar with the mastery strategy may find these stributions "abnormal" or "disturbing", or indicative of a soft proach to evaluations. Mastery teachers may have to explain the rategy to disapproving colleagues.

In those courses where its use is appropriate, the mastery aching strategy promises not only to produce better trained students, t more satisfied learners since most members of a class will be le to point to concrete evidence of their own achievements.

3. What does criterion-referenced mean?

Norm-referenced testing is what we all know as "normal" testing: students are placed in rank order, and the top 10% are given Grade 1, and so on. Or it may be that the "top 80%" will be awarded a "pass", and the remainder will be classed as "failures". In each case, the point of reference is the group norm or norms.

With C.R.T., the reference point is a *pre-determined* criterion score. Thus a teacher may say "Any child in this group who has mastered the skill of ... will be able to answer correctly 70% of the items in this test". In a more refined version, the teacher may demand a 70% pass in *each* content area, objective or other sub-division.

In the case of the mastery tests, one skill only (and thus one objective only and one content area only) is approached in each test. There are, however, several different question types in most tests, and some teachers might wish to take this into account, calling (say) for "four items correct in each set of five items".

4. Can the tests be used for norm-referenced testing and reporti

There are very good reasons why they *should not* be used for ranking purposes. This is shown by a hypothetical example:

Consider a student "X" who normally tops her class.

In a norm-referenced test, with a roughly "normal" distribution, a class of forty might have this distribution of scores:

Score	0	1	2	3	4	5	6	7	8	9	10
Number of students	1	2	3	4	5	10	5	4	3	2	1

If a student "X" makes two mistakes, she will drop from 10 to 8, and from first place to equal fourth place.

But in a mastery test, the score distribution will look more like this:

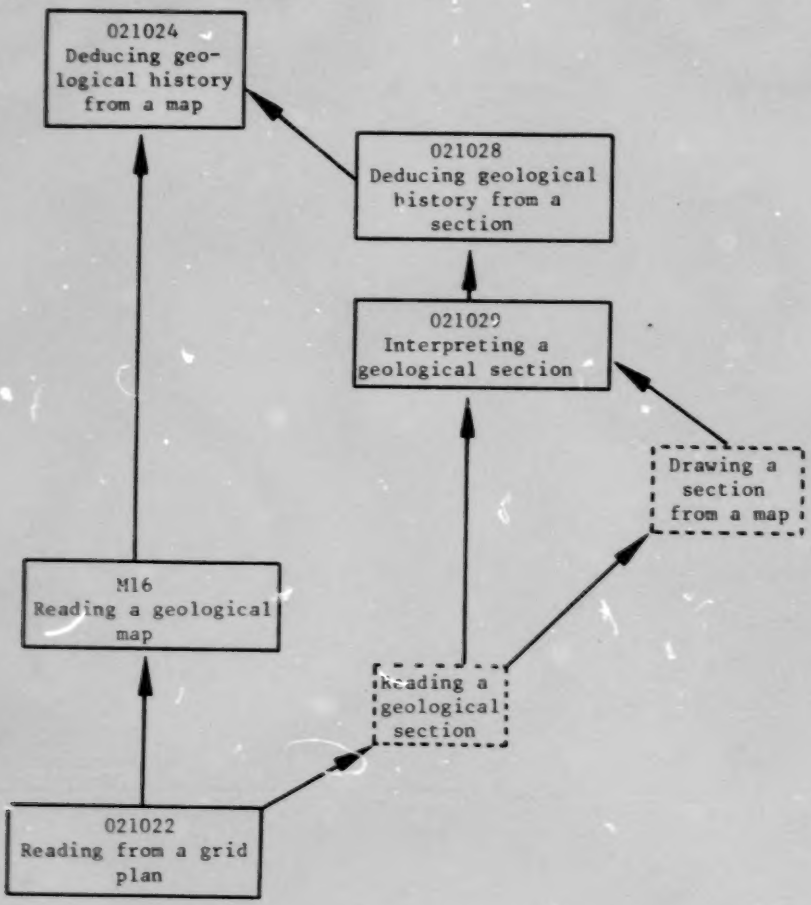
Score	0	1	2	3	4	5	6	7	8	9	10
Number of students	0	0	0	0	0	0	1	3	4	10	22

Student "X" making the same errors would now drop from equal first to equal thirty-third, an obviously unreasonable penalty for two errors.

In the norm-referenced test the penalty for the *same* mistakes was much less. In addition ranking can be justified only when there is a sensible spread of students. Mastery tests are not designed to spread students but are designed to determine whether or not the bulk of students have mastered a given skill.

5. How are the mastery tests developed?

The first few tests were developed from single items, using items from the Science Library of Test Items as starting points. It then became obvious that there were logical structures to be built up, much in the style of Gagné's (4) learning hierarchies. Here is an example:



The first test developed in this series was 021024, "Deducing geological history from a map", and the underlying skills were then identified. Test 021029 has been trialled and found to be too hard. Test 021028 has been reviewed (but not trialled) and dropped as too hard. "Reading a geological section" will be the subject of a future test, and "Drawing a section from a map" will be developed in the future as a free response test, to be issued separately from the mastery programme.

In other cases, members of the writing groups were invited to join in "brainstorming" sessions which produced new titles, arising out of questions such as "what should students be able to measure?" In other cases, writers identified skills in their day-to-day teaching and wrote tests to suit.

The main point arising from this is that some of the testable skills are of quite a high cognitive order, and that hence each will be underlain by simpler skills. In some cases, such as 021022, "Reading from a grid plan", these skills are more related to doing the test : test M16 uses a grid plan superimposed on a diagram. Students unfamiliar with this usage may fail to demonstrate mastery, not because they have not mastered the skill, but because they cannot master the test.

New test topics, then, are generated:

(i) by brainstorming,

(ii) by looking at item bank items,

(iii) by analysing the existing tests for necessary subordinate skills, and

(iv) in response to suggestions from practising teachers.

Once a "topic" has been selected, it is necessary to identify the skill(s) which are related to it, and at this point, it is necessary to explain what is meant, in this context, by "skill".

6. What is a "skill"?

The original meaning of the term skill appears to have been that used, for example, by Kruglak (5): this was "laboratory skill": essentially a psychomotor skill involving the manipulation of apparatus. Kruglak sought, without much success, to develop "pencil and paper analogues of tests of skills".

There are, however, two underlying aspects of such a "skill" which are amenable to pencil and paper testing : "knowing what to use", and "knowing how to use it". Thus, in the case of a skill such as "using a microscope", it is important that a student be able to distinguish the nose-piece from the coarse focus, and the coarse focus from the condenser adjustment. And it is important that the student know what each does, and when to use it. All trivial skills, but very important to prolonging the life of a microscope.

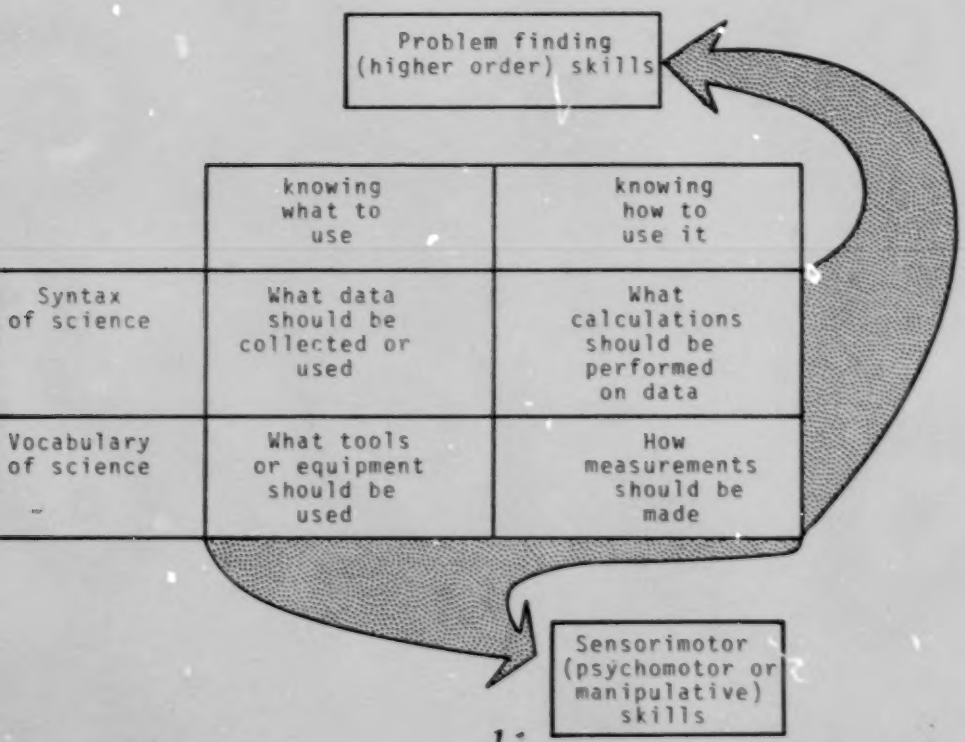
"Skill" may also be defined as "the ability to solve a problem". This is not changing the subject, because Bruner (2) has some useful things to say about problems.

Firstly, Bruner sees those problems "... that relate to logical implications, identity, equivalence, and transformational rules". These are the syntax of science, and typical problems/skills are calculating acceleration from a set of velocities or interpreting a geological map, but not drawing a geological map which falls into the "sensorimotor" area.

Secondly, there are the problems which constitute the vocabulary of science. Most of these involve some kind of measurement : voltage, height, weight, and so on.

Finally, there is that group of skills which may be called problem-finding. These skills are cerebral ones, involving original and creative thinking in a scientific mode. The demonstration of these skills depends on insightful understanding of the deep structures of science. Many teachers would question whether such understanding is characteristic of average school children.

There are, of course, many other ways of defining skills, but those described have proved sufficient for the purpose of generating mastery tests, as indicated in this model:


Problem finding (higher order) skills
knowing what to use
knowing how to use it
Syntax of science
What data should be collected or used
What calculations should be performed on data
Vocabulary of science
What tools or equipment should be used
How measurements should be made
Sensorimotor (psychomotor or manipulative) skills

7. What tests are available?

This information is supplied below. It will be noted that tests are at many stages of development : the next printing will become available for release in late August 1978, and further releases will follow. Some new tests are being written.

Test No.	Test Name	Status
021001	Reading a table	Available as M1
021002	Using a biological key	Available as M2
021003	Identifying chemical symbols	Available as M3
021004	Identifying parts of a human body (respiratory/alimentary)	Available as M4
021005	Using a table of geological periods	Deleted after trials
021006	Reading a line graph	Available as M5
021007	Identifying electronic and electrical symbols	Available as M6
021008	Naming laboratory apparatus	Available as M7
021009	Identifying laboratory apparatus	Available as M8
021010	Selecting laboratory apparatus	Deleted after trials
021011	Identifying the bones of a human skeleton : form A : technical names	Available as M9
021012	Identifying the bones of a human skeleton : form B : common names	Available as M10
021013	Naming the branches of science	Available as M11
021014	Reading a linear scale	Ready to print in trial form
021015	Converting metric length	Being reconsidered
021016	Converting metric mass (kg and g)	Available as M12
021017	Converting metric volume	Being reconsidered
021018	Estimating metric length (millimetres and metres)	Rerun as 021077
021019	Identifying hazards in a laboratory	Available as M13
021020	Calculating an average	Available as M14
021021	Identifying parts of the scientific method	Available as M15
021022	Reading from a grid plan	Likely to be released
021023	Reading a geological map	Available as M16
021024	Interpreting a geological map	Not to be used in this form
021025	Identifying elements, mixtures and compounds	Available as M17
021026	Identifying parts of a flower	Artwork required only
021027	Naming parts of a flower	Artwork required only
021028	Deducing geological history from a section	Currently being re-writt
021029	Interpreting a geological section	Not to be used in this form
021030	Reading a circular scale (1)	Ready to print in trial form
021031	Reading a circular scale (2)	Being reconsidered

1032	Recognising vertebrate classes	Awaiting review
1033	Identifying common arthropods	Likely to be released
1034	Naming common arthropods	Artwork required only
1035	Identifying characteristics of vertebrate classes	Likely to be released
1036	Identifying parts of the eye	Awaiting trials.
1037	Naming parts of the eye	Likely to be released
1038	Identifying functions of parts of the eye	combined with .036 and .037
1039	Predicting the paths of refracted rays	Artwork required only
1040	Identifying elements from descriptions	Likely to be released
1041	Identifying rocks	Unlikely to be released in this form
1042	Classifying minerals	In need of careful revision
1043	Applying the activity series of metals	Likely to be released
1044	Interpreting ticker tapes	Acceptable with minor revision
1045	Calculating from ticker tapes	Artwork required
1046	Using Ohm's law in calculation	Available as M18
1047	Interpreting food chains, webs and pyramids	Available as M19
1048	Interpreting an evolutionary "family tree"	Likely to be released
1049	Estimating percentage composition of rocks	Being reconsidered
1050	Recognising amplitude wave length frequency	Being reconsidered
1051	Measuring amplitude wave length frequency	Being reconsidered
1052	Recognising angles of incidence, reflection and refraction	To be re-written
1053	Measuring angles of incidence reflection and refraction	Available as M20
1054	Interpreting a mechanical diagram	To be re-written
1055	Calculating kinetic energy	Available as M21
1056	Completing a genetic table	To be re-written
1057	Predicting genetics F, ratios	Gone to printer
1058	Using F = ma	Available as M22
1059	Using a table of geological periods (revised)	Available as M23
1060	Identifying forms of animal reproduction	Being reconsidered
1061	Using scientific notation 1	Likely to be released
1062	Using scientific notation 2	Available as M24
1063	Recognising cellular features	Being reconsidered
1064	Manipulating equations	Available as M25
1065	Dividing in scientific notation	Likely to be released
1066	Undertaking experimental design	Available as M26
1067	Lab safety	To be re-written

021068	Using Ohm's law 2	Likely to be released
021069	Interpreting family trees in genetics	To be re-written
021070	Using codes 1	Likely to be released with corrections
021071	Using codes 2	Prepared for printing
021072	Using codes 3	Ready to print in trial form
021073	Naming the parts of the microscope and their functions	Likely to be released
021074	Naming carbon compounds 1	Ready to print in trial form
021075	Naming carbon compounds 2	Ready to print in trial form
021076	Calculating density and predicting flotation	Likely to be released
021077	Estimating metric length (millimetres and metres) (REVISED EDITION)	Could be released
021078	Using SI symbols	Likely to be released
021079	Using s = vt	Likely to be released
021080	Applying a novel theory	Likely to be released
021081	Predicting the direction of a magnetic field 1	Likely to be accepted with corrections
021082	Predicting the direction of a magnetic field 2	In need of careful revision
021083	Reading a flow diagram	Ready to print in trial form
021084	Using a flow chart of physical processes	Ready to print in trial form
021085	Identifying trends in data	Ready to print in trial form
021086	Applying Ohm's law	Edited, ready to type
021087	Recognising resistances in series and parallel	Artwork required
021088	Applying averages	Ready to print in trial form
021089	Interpreting a flow chart of operations	Ready to print in trial form
021090	Applying a scientific theory	Ready to print in trial form
021091	Multiplying in scientific notation	Ready to print in trial form
021092	Interpreting a chart of the electro-magnetic spectrum	Artwork required only
021093	Interpreting a weather map	Edited, ready to type
021094	Interpreting atomic numbers and mass numbers	Edited, ready to type
021095	Reading a graph by interpolation	Awaiting review
021096	Applying kinetic theory	Awaiting review
021097	Analysing a bar graph	Awaiting review

)21098	Fitting graphs to data	Awaiting review
)21099	Applying the particle theory (1)	Awaiting review
)21100	Applying the particle theory (2)	Awaiting review
)21101	Selecting correct SI units	Awaiting review
)21102	Applying the theory of radioactivity	Awaiting review
)21103	Interpreting a contour map	Awaiting review
21104	Correlating fossil sequences	Ready to print in trial form
21105	Designing an experiment	Awaiting review
21106	Extrapolating from a geological map	Ready to print in trial form
21107	Matching geological sections and maps	Ready to print in trial form
21108	Identifying correct microscope usage	Ready to print in trial form
21109	Identifying the functions of parts of a plant	Ready to print in trial form
21110	Interpreting food test results	Ready to print in trial form
21111	Applying the theory of mechanical advantage	Ready to print in trial form

8. When should a mastery test be given?

A mastery test may be given

(i) before a course or unit starts, to measure students' *readiness* for that topic, and also to determine *placement* in classes,

(ii) during a course or unit to determine needs for *remediation*. This may also be done prior to the start of the course or unit.

(iii) at the conclusion of a course or unit to assess student mastery of skills thus identifying those who need remediation, and to evaluate the effectiveness of the teaching style used in imparting the skill(s).

9. How long should students have to complete a test?

This will depend on the teacher and the class.

In many cases ten minutes would be sufficient, and in all cases, one period should be adequate. Individual students will require different times, and teachers may well prefer to have individual students take tests when they are ready to attempt them.

10. How is mastery of a skill determined?

The question of a 'cutting score" is difficult. This is the mark to be achieved by a student who has mastered the material. The question is a technical one, and will be discussed in a detailed paper to be released later this year.

The final decision must be made in the school, based on the informed professional judgement of the teacher. The sources of information are:

(i) Knowledge of the students' capabilities, age, and prior experience,

(ii) Knowledge of the characteristics of the test. This may be obtained by viewing the statistics printed on the back page of the test. These are selected from the trial sample, and represent the performances recorded by the two most populous years in the sample.

A note of caution must, however, be sounded : no attempt was made to control the prior experience or abilities of the sample students. This can lead to apparent anomalies, with a Year 7 performance excelling a Year 10 performance. Events such as these are further warnings that the analyses provided *should not and can not be used as State-wide norms.*

11. What are the limitations of a mastery test?

While it must be recognised that the mastery tests are directed at basic cognitive competences, it should also be recognised that these are not topic tests, they do not purport to be a complete list of skills, and they do not carry any official *imprimatur*.

In general, the following areas are largely untouched by the mastery programme:

(i) the higher cognitive skills
(ii) the affective domain
(iii) most of the psychomotor domain
(iv) communication skills.

Material which is currently being prepared will help teachers to test science students in these areas. The Library of Test Items covers many higher cognitive skills. The Free Response Test Development Programme will cover much of the affective domain, some psychomotor skills such as drawing diagrams, and written communication skills. A Guide to Practical Testing has been drafted for discussion : this will cover the rest of the psychomotor domain, and possibly some non-written communication skills.

12. What effect could the mastery tests have on the curriculum?

If they are used wisely, the mastery tests can be a powerful tool for assessing mastery of skills. It is essential that the tests remain our tools, and do not become our masters.

If used unwisely, the mastery tests could have a bad effect : teachers who gleefully seize on this system as a programming frame will, as indicated above, leave out many important areas.

Wise use can be achieved by selecting those tests which reflect skills already taught in your school, and being fairly conservative in adding to that list.

13. What should go in the markbook?

Probably a record of attempts on various tests should be recorded, together with a notation such as "N" or "M" for "non-mastery" or "mastery".

It will be noted that the answer sheet *proforma* in Appendix 2 includes a space for the name of the person who marked the test. This is to allow for the situation in which the student marks his own answers, or students exchange papers for marking.

Some teachers who have been involved in writing tests and in trials have indicated that they will display a relevant set of tests on the laboratory walls, and allow students to attempt the various tests as and when they (the students) feel ready to do so.

14. How can teachers write their own mastery tests?

The essential elements in developing a mastery test are:

1. Identify a specific skill.
2. Identify an item or a series of item forms which can be used : test M1 has three item forms, test M2 has only one.
3. Generate a series of items which covers the range of the item form. In the case of M1, all parts of the table are covered, in the case of M2, all parts of the phylum Invertebrata are covered.
4. Present the items, with stimulus material as required, to some students whom you consider to have mastered the skill in question.
5. Collect basic statistics : score distribution, and how many got each question right (*"hands up those who got Q.9 right", and record "all", "lots", "some", "a few", none"*)
6. Revise your test and then share it with others.

BIBLIOGRAPHY

1. Bloom, Benjamin S. in Bloom, Hastings & Madaus *Handbook of Formative and Summative Evaluation of Student Learning*, New York:McGraw-Hill, 1971
2. Bruner, Jerome S. *The Relevance of Education*, Harmondsworth: Penguin Books, 1974.
3. Carroll, John B. A Model of School Learning, *Teachers College Record*, 1963, 64, 723-
4. Gagne, Robert M. *The Conditions of Learning*, 2nd edition. London: Holt Rinehart and Winston, 1970.
5. Kruglak, Haym. The Measurement of Laboratory Achievement, *American Journal of Physi* 1954, 22, 442-462.

FURTHER READING

Block, J.H. & Anderson, L.W. *Mastery learning in classroom instruction*, New York: Macmillan Publishing Co., 1975.

Gronlund, Norman E. *Stating Behavioural Objectives for Classroom Instruction*, London: The Macmillan Company, 1970.

Gronlund, Norman E. *Preparing Criterion-Referenced Tests for Classroom Instruction*, London: The Macmillan Company, 1973.

Hively, Wells (ed.) *Domain-Referenced Testing*, Englewood Cliffs, New Jersey: Educational Technology Publications, 1974. (Also printed as the June issue of the journal *Educatio Technology*).

How to order sets of tests for classroom use

The order form opposite should be detached, completed, and forwarded to the address shown. To help you decide which tests are most suitable, the actual tests listed by title below are reproduced in the pages which follow, in greatly reduced form. Although the actual test pages are (255 mm x 190 mm) format, they are reproduced here, two to a page, for preview purposes only. Each *set* consists of 20 copies of the test, a yellow answer sheet reproduction master and a pink marking templet. Sufficient sets and half-sets of suitable tests should be ordered, to cater for the largest class which will use them (e.g. one set for a class of 20, one and a half sets for a class of 30). Where only one half-set of a test is ordered the answer sheet master and marking templet will be included.

Titles of tests which may be ordered

M1 Reading a Table
M2 Using a Biological Key
M3 Identifying Chemical Symbols
M4 Identifying Parts of a Human Body (respiratory/alimentary)
M5 Reading a Line Graph
M6 Identifying Electronic and Electrical Symbols
M7 Naming Laboratory Apparatus
M8 Identifying Laboratory Apparatus
M9 Identifying the Bones of a Human Skeleton : Form A : Technical Names
M10 Identifying the Bones of a Human Skeleton : Form B : Common Names
M11 Naming the Branches of Science
M12 Converting Metric Mass (kg and g)
M13 Identifying Hazards in a Laboratory
M14 Calculating an Average
M15 Identifying Parts of the Scientific Method
M16 Reading a Geological Map
M17 Identifying Elements, Mixtures and Compounds
M18 Using Ohm's Law in Calculation
M19 Interpreting Food Chains, Webs and Pyramids
M20 Measuring Angles of Incidence, Reflection and Refraction
M21 Calculating Kinetic Energy
M22 Using F = ma
M23 Using a Table of Geological Periods (revised)
M24 Using Scientific Notation 2
M25 Manipulating Equations
M26 Undertaking Experimental Design

CUT ALONG THIS LINE

ORDER FORM FOR SETS OF MASTERY TESTS

TO: The Chief Services Officer
School Certificate Development Unit,
P.O. Box 460, NORTH SYDNEY 2060

Please send me the following sets of Science Mastery tests

TITLE See checklist on facing page: where space is insufficient, attach photocopies of this form.	Number of Tests Required	
	Sets of 20	Half Sets of 1

I certify that the quantity specified is the minimum appropriate to the requirements of this school. ..... Head of Department.

.....
(Principal's Signature) / /

SCHOOL: _____

ADDRESS: _____

_____

_____ POSTCODE: _____

Please keep a photocopy of this order, for your records.

MASTERY TEST KEYS

Test No: M1

1 A 2 C 3 C 4 C 5 D 6 D 7 D 8 C 9 A 10 B

11 A 12 C 13 D 14 B 15 B

Test No: M2

1 C 2 C 3 C 4 A 5 C 6 A 7 C 8 A 9 D 10 C

Test No: M3/2

1 B 2 A 3 C 4 C 5 A 6 D 7 D 8 B 9 C 10 A

11 A 12 B 13 C 14 D 15 A 16 C 17 A 18 C 19 D 20 C

Test No: M4/2

1 C 2 B 3 A 4 B 5 A 6 A 7 D 8 C 9 C 10 D

11 C 12 A 13 D 14 A 15 B

Test No: M5

1 D 2 A 3 A 4 C 5 B 6 B 7 B 8 B 9 D 10 A

11 A 12 C 13 B 14 D 15 D

Test No: M6

1 B 2 D 3 A 4 B 5 C 6 C 7 D 8 A 9 E 10 D

11 D 12 A 13 B 14 C 15 C 16 A 17 C 18 B 19 A 20 B

Test No: M7

1 A 2 C 3 D 4 C 5 A 6 A 7 B 8 C 9 C 10 B

11 A 12 D 13 D 14 A 15 C

Test No: M8

1 B 2 C 3 D 4 C 5 A 6 C 7 A 8 B 9 C 10 B

11 D 12 B 13 A 14 B 15 A

MASTERY TEST KEYS

Test No: M9

1 C 2 B 3 D 4 C 5 B 6 A 7 D 8 D 9 C 10 B

11 B 12 A 13 C 14 D 15 A

Test No: M10/2

1 A 2 C 3 B 4 D 5 D 6 B 7 A 8 A 9 C 10 D

11 C 12 A 13 B 14 A 15 D

Test No: M11

1 A 2 A 3 C 4 D 5 C 6 D 7 A 8 A 9 D 10 B

11 A 12 C 13 D 14 B 15 C

Test No: M12/2

1 A 2 A 3 B 4 B 5 A 6 A 7 C 8 B 9 D 10 C

11 C 12 A 13 C 14 B 15 D 16 C 17 A 18 B 19 D 20 D

Test No: M13

1 D 2 B 3 B 4 D 5 C 6 B 7 C 8 B 9 A 10 A

Test No: M14

1 C 2 D 3 B 4 C 5 A 6 D 7 A 8 C 9 B 10 A

11 D 12 B 13 C 14 A 15 A 16 B 17 C 18 C 19 C 20 A

Test No: M15/2

1 D 2 C 3 C 4 A 5 C 6 B 7 C 8 B 9 C 10 D

Test No: M16

1 C 2 C 3 B 4 A 5 D 6 C 7 D 8 B 9 D 10 A

11 D 12 B 13 A 14 A 15 A

MASTERY TEST KEYS

Test No: M17/2

1 A 2 D 3 B 4 D 5 C 6 A 7 B 8 C 9 B 10 B

11 C 12 C 13 D 14 A 15 D 16 B 17 C 18 A 19 A 20 C

Test No: M18/2

1 A 2 B 3 C 4 D 5 B 6 C 7 A 8 A 9 C 10 B

11 B 12 C 13 A 14 A 15 C 16 C 17 A 18 A 19 B 20 A

Test No: M19

1 B 2 C 3 D 4 A 5 A 6 C 7 A 8 B 9 C 10 D

11 D 12 C 13 A 14 D 15 B

Test No: M20

1 B 2 B 3 D 4 A 5 C 6 B 7 C 8 A 9 C 10 B

11 A 12 C 13 A 14 A 15 D

Test No: M21/2

1 B 2 A 3 D 4 C 5 C 6 A 7 B 8 D 9 D 10 C

11 A 12 B 13 C 14 D 15 C 16 D 17 C 18 A 19 B 20 D

Test No: M22/2

1 C 2 B 3 A 4 A 5 B 6 B 7 A 8 C 9 D 10 A

11 A 12 C 13 D 14 D 15 C 16 C 17 A 18 A 19 B 20 A

Test No: M23

1 C 2 C 3 B 4 C 5 B 6 C 7 C 8 A 9 C 10 A

11 A 12 B 13 C 14 A 15 A 16 C 17 A 18 D 19 B 20 A

MASTERY TEST KEYS

Test No: M24

1 D 2 B 3 C 4 C 5 C 6 C 7 C 8 B 9 C 10 B

11 A 12 B 13 B 14 D 15 C 16 A 17 C 18 B 19 A 20 D

Test No: M25

1 C 2 C 3 D 4 B 5 C 6 D 7 A 8 B 9 C 10 C

11 D 12 A 13 B 14 D 15 A 16 B 17 C 18 D 19 A 20 D

Test No: M26

1 C 2 C 3 B 4 D 5 C 6 D 7 D 8 B 9 C 10 A

Mastery Test Answer Sheet. Name: _____ Class ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

Test No: ___ Name: _____ Score: ___ Marked By: _____

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 ___

11 ___ 12 ___ 13 ___ 14 ___ 15 ___ 16 ___ 17 ___ 18 ___ 19 ___ 20 ___

APPENDIX 3

INSPECTION COPIES

The sample tests in this appendix are reproduced in sizes different from that in which they will finally appear. The two centre pages are reduced in size to fit a foolscap sheet, and the back page is larger than the final product. It must be stressed that the test pages are NOT reproduced as a set of print masters. Their use for such a purpose would invalidate certain questions, in that reproductions of these reduced versions would be unsatisfactory.

Use this table to answer the questions on the next page.

Dry Bulb Temp (°C)	RELATIVE HUMIDITY OF AIR — DIFFERENCE BETWEEN WET AND DRY BULB TEMP. (°C)														
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°
0	81	64	46	29	13										
1	83	66	49	33	17										
2	84	68	52	37	22	7									
3	84	70	55	40	26	12									
4	85	71	57	43	29	16									
5	86	72	58	45	33	20	7								
6	86	73	60	48	35	24	11								
7	87	74	62	50	38	26	15								
8	87	75	63	51	40	29	19	8							
9	88	76	64	53	42	32	22	12							
10	88	77	66	55	44	34	24	15	6						
11	89	78	67	56	46	36	27	18	9						
12	89	78	69	58	48	39	29	21	12						
13	89	79	69	59	50	41	32	23	15	7					
14	90	79	70	60	51	42	34	26	18	10					
15	90	80	71	61	53	44	36	27	20	13	6				
16	90	81	71	63	54	46	38	30	23	15	8				
17	90	81	72	64	55	47	40	32	25	18	11				
18	91	82	73	65	57	49	41	34	27	20	14	7			
19	91	82	74	65	58	50	43	36	29	22	16	10			
20	91	83	74	66	59	51	44	37	31	24	18	12	6		
21	91	83	75	67	60	53	46	39	32	26	20	14	8		
22	92	83	76	68	61	54	47	40	34	28	22	17	11	5	
23	92	84	76	69	62	55	48	42	36	30	24	19	13	8	
24	92	84	77	69	62	56	49	43	37	31	26	20	15	10	5
25	93	84	77	70	63	57	50	44	39	33	28	22	17	12	8
26	92	85	78	71	64	58	51	46	40	34	29	24	19	14	10
27	92	85	78	71	65	58	52	47	41	36	31	26	21	16	12
28	93	85	78	72	65	59	53	48	42	37	32	27	22	18	13
29	93	86	79	72	66	60	54	49	43	38	33	28	24	19	15
30	93	86	79	73	67	61	55	50	44	39	35	30	25	21	17
31	93	86	80	73	67	61	56	51	45	40	36	31	27	22	18
32	93	86	80	74	68	62	57	51	46	41	37	32	28	24	20
33	93	87	80	74	68	63	57	52	47	42	38	33	29	25	21
34	93	87	81	75	69	63	58	53	48	43	39	35	30	28	23

A "wet and dry bulb thermometer" is used to measure humidity. The "wet bulb" has wet cotton wool around it, and the "dry bulb" has nothing. To measure humidity, you do this:

1. Read the dry bulb thermometer and write down the temperature.

2. Read the wet bulb thermometer and write down the DIFFERENCE between the two thermometers.

3. Use the relative humidity table opposite to find the humidity.

Use the table to find the answer which fits into the blank space and mark the letter (A, B, C or D) for that question on your answer sheet.

Question	Dry Bulb Reading	Difference	Relative Humidity	A	B	C	D
1	32°	13°		28%	29%	32%	33%
2	34°	3°		75%	80%	81%	87%
3	11°	4°		46%	55%	56%	58%
4	30°	6°		55%	56%	61%	67%
5	4°	2°		37%	43%	70%	71%
6		13°	29%	0°	12°	26°	33°
7		9°	44%	10°	15°	20°	30°
8		8°	36%	11°	15°	19°	23°
9		2°	68%	[illegible]°	12°	22°	32°
10		5°	58%	12°	19°	26°	34°
11	26°		34%	10°	11°	12°	13°
12	0°		46%	1°	2°	3°	4°
13	35°		69%	2°	3°	4°	5°
14	8°		40%	4°	5°	6°	7°
15	15°		44%	5°	6°	7°	8°

Appendix 3/2

TEACHERS' NOTES

This test is designed to determine whether or not the student can use a table to obtain information.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
8	164	63%	77%	84%	87%	89%	91%	93%	96%	4%
9	123	67%	83%	92%	93%	95%	96%	97%	98%	2%

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Questions 1-5 - Students may have problems recognising that the required information is to be found at the intersection of the co-ordinates.

Questions 6 -15 - Students may have problems extrapolating from the body of data to the axes.

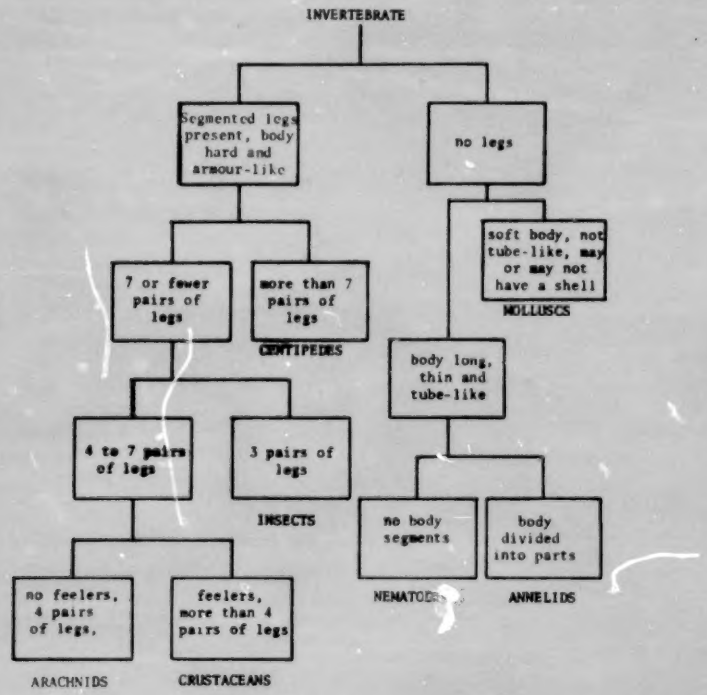
General: Students may need to be directed to use a ruler in reading from the table.

Related skills for which tests have not been prepared:

Constructing a table
Organising data into a table
Transposing information from graphs and prose to tables (and *vice versa*)
Extracting trends and sequences from tabulated information.

The diagram below may be used to identify the "group" in which an invertebrate belongs.

Start at "Invertebrate", and choose either the "legs" box or the "no legs" box. Then make another choice, and so on, until you have reached a box which ends in the name of a group. You have now identified your invertebrate.



For each of the pictured animals, choose the correct group from the four named. Mark its letter (A, B, C or D) on your answer sheet.

1		Arachnid	Centipede	Crustacean	Insect
2		A Annelid	B Crustacean	C Mollusc	D Nematode
3		A Arachnid	B Centipede	C Crustacean	D Insect
4		A Centipede	B Crustacean	C Insect	D Mollusc
5		A Arachnid	B Crustacean	C Insect	D Mollusc
6		A Annelid	B Insect	C Mollusc	D Nematode
7		A Annelid	B Arachnid	C Mollusc	D Nematode
8		A Arachnid	B Centipede	C Crustacean	D Insect
9		A Annelid	B Centipede	C Mollusc	D Nematode
10		A Arachnid	B Centipede	C Insect	D Mollusc

TEACHERS' NOTES

This test is designed to determine whether or not the student can use a classification flow diagram.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥10	≥ 9	≥ 8	≥7	≥6	≥5	≥4	≥ 3	<3
7	245	5%	18%	40%	65%	80%	90%	96%	99%	1%
10	290	18%	51%	74%	89%	96%	99%	100%	100%	0

In general a student achieving a score of 8 out of 10 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Students may have a lack of familiarity with biological keys. Students may not be observing diagrams closely enough. Students may be unable to disting between body parts.

Related tests

Two other tests involving flow diagrams are in preparation.

Related skills for which tests have not been prepared:

Observing specimens and noting characteristics
Drawing and labelling lines on prepared specimens accurately
Classifying actual specimens using the key
Classifying groups of things on related characteristics

Identifying chemical symbols

In this set, select the symbol which matches the element named and mark its letter (A, B, C or D) on your answer sheet.

Question		A	B	C	D
1	Hydrogen has the symbol	He	H	Hy	Hg
2	Sodium has the symbol	Na	S	So	N
3	Nitrogen has the symbol	Na	Ne	N	Ni
4	Carbon has the symbol	Ca	Cr	C	Cn
5	Chlorine has the symbol	Cl	Ch	Co	Cr
6	Calcium has the symbol	C	Cu	Cl	Ca
7	Potassium has the symbol	P	Ka	Po	K
8	Boron has the symbol	Bo	B	Bn	Br
9	Oxygen has the symbol	Oy	On	O	Ox
10	Lithium has the symbol	Li	Be	Ba	Lt

Identifying chemical symbols

In this set, select the element which matches the symbol, and mark its letter (A, B, C or D) on your answer sheet.

Question		A	B	C	D
11	Cu is the symbol for	Copper	Chromium	Calcium	Curium
12	Fe is the symbol for	Fluorine	Iron	Fermium	Iodine
13	Hg is the symbol for	Hydrogen	Helium	Mercury	Silver
14	Sn is the symbol for	Strontium	Zinc	Sodium	Tin
15	He is the symbol for	Helium	Hydrogen	Helicon	Henrium
16	Si is the symbol for	Silver	Scandium	Silicon	Selenium
17	P is the symbol for	Phosphorus	Lead	Potassium	Plutonium
18	Be is the symbol for	Berkelium	Bromine	Beryllium	Bellium
19	S is the symbol for	Sodium	Silver	Silicon	Sulphur
20	Ne is the symbol for	Neptunium	Nerium	Neon	Nitrogen

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify the chemical symbols for the more common elements.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		⩾20	⩾19	⩾18	⩾17	⩾16	⩾15	⩾14	⩾13	<13
8	217	2%	15%	33%	46%	60%	71%	78%	84%	16%
10	124	22%	33%	51%	65%	76%	81%	83%	87%	13%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

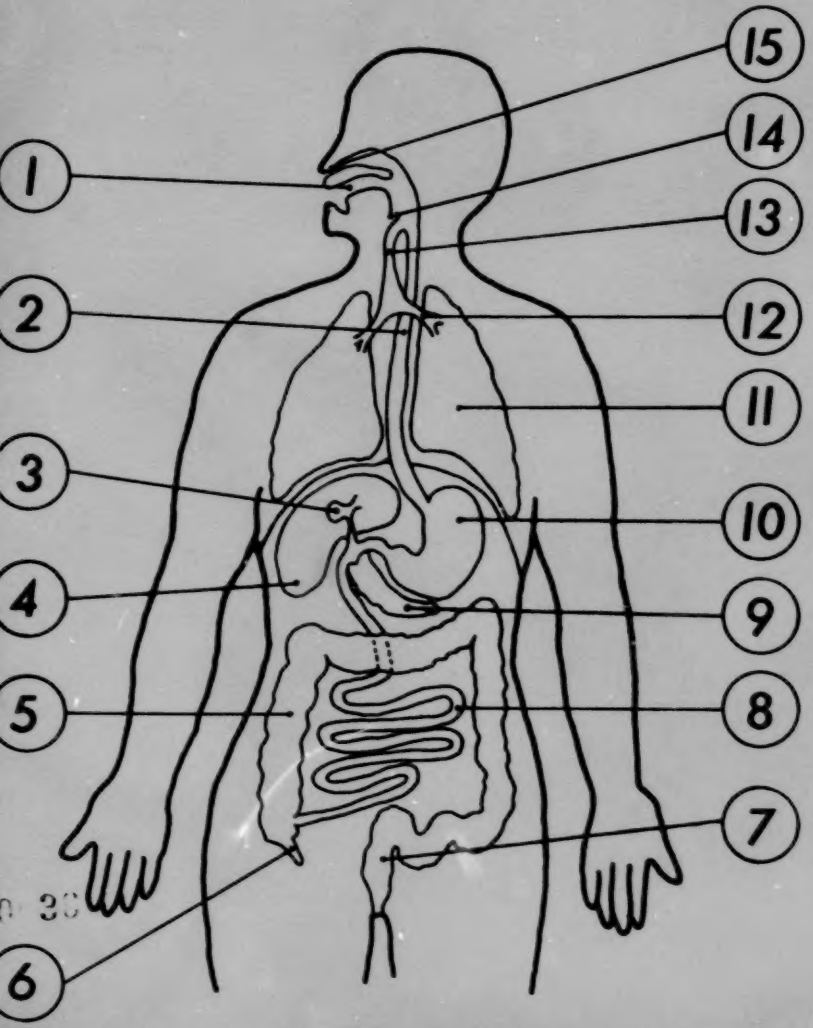
Low scores on certain sets of questions may indicate specific problems as indicated below:

Lack of familiarity with chemical symbols.

Related skills for which tests have not been prepared:

Recognising chemical formulae.

The questions in this test refer to this diagram. The numbers indicate the body part for each question.



For each item, select the correct name from the four choices, and write its letter (A, B, C or D) on your answer sheet.

QUESTION	A	B	C	D
1	tongue	larynx	mouth	throat
2	lung	oesophagus	throat	trachea
3	gall bladder	liver	pancreas	stomach
4	gall bladder	liver	pancreas	stomach
5	large intestine	rectum	small intestine	duodenum
6	appendix	colon	rectum	small intestine
7	anus	colon	large intestine	rectum
8	appendix	pancreas	small intestine	stomach
9	gall bladder	liver	pancreas	stomach
10	large intestine	liver	pancreas	stomach
11	heart	liver	lung	stomach
12	bronchus	gullet	lung	trachea
13	bronchus	gullet	oesophagus	trachea
14	epiglottis	neck	throat	tongue
15	mouth	nostril	salivary gland	tongue

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify parts of the human body (alimentary/respiratory).

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
9	203	1%	17%	31%	51%	61%	67%	76%	83%	17%
10	123	10%	32%	46%	58%	70%	82%	87%	94%	6%

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Lack of familiarity with the parts mentioned
Inability to distinguish between organs

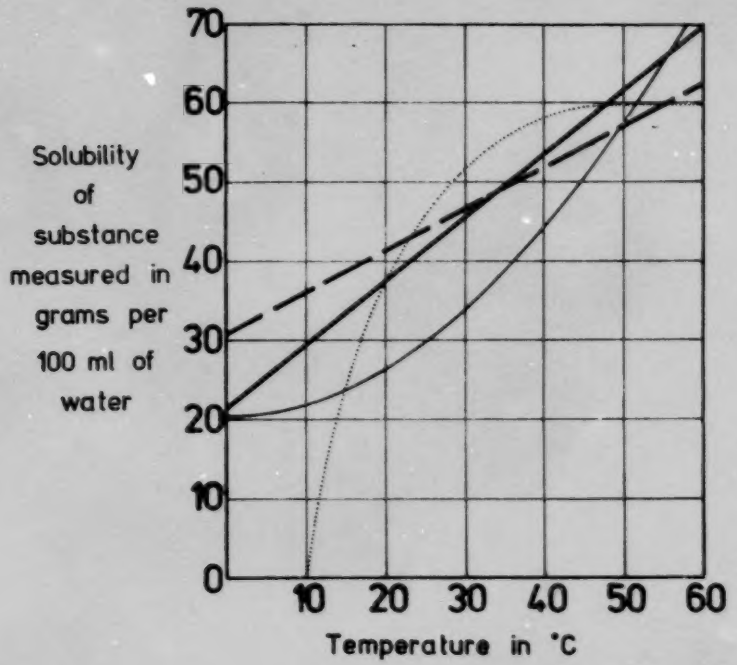
Related tests:

M9 - Identifying the bones of a human skeleton : Form A
M10 - Identifying the bones of a human skeleton : Form B
021036 - Identifying parts of the eye

Related skills for which tests have not been prepared:

Identifying organs and parts of the human body not specified above.

The next 15 questions refer to this graph.



SET 1

For each question, identify the substance with the highest solubility at the stated temperature. Mark its letter (A, B, C or D) on your answer sheet.

QUESTION	TEMPERATURE	ANSWER			
1	20°	A	B	C	D
2	30°	A	B	C	D
3	40°	A	B	C	D
4	50°	A	B	C	D
5	60°	A	B	C	D

SET 2

For each question, identify the substance with the lowest solubility at the stated temperature. Mark its letter (A, B, C or D) on your answer sheet.

QUESTION	TEMPERATURE	ANSWER			
6	20°	A	B	C	D
7	30°	A	B	C	D
8	40°	A	B	C	D
9	50°	A	B	C	D
10	60°	A	B	C	D

SET 3

For each question, identify the substance with the stated solubility at the stated temperature.

QUESTION	SOLUBILITY AND TEMPERATURE	ANSWER			
11	52gm/100ml at 30°C	A	B	C	D
12	28gm/100ml at 10°C	A	B	C	D
13	45gm/100ml at 40°C	A	B	C	D
14	42gm/100ml at 20°C	A	B	C	D
15	62gm/100ml at 60°C	A	B	C	D

TEACHERS' NOTES

This test is designed to determine whether or not the student can read a line graph.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥ 15	≥ 14	≥ 13	≥ 12	≥ 11	≥ 10	≥ 9	≥ 8	< 8
9	122	52%	82%	87%	91%	95%	96%	96%	99%	1%
10	235	49%	80%	85%	89%	91%	92%	94%	94%	6%

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 3: Difficulty in using co-ordinates to locate a plot point.

Related tests:

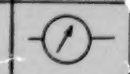
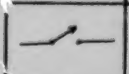
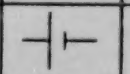
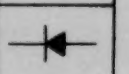
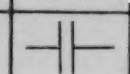
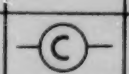
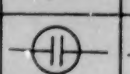
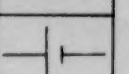
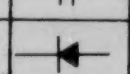
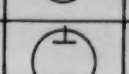
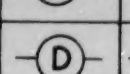
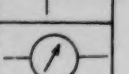
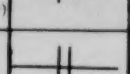
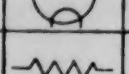
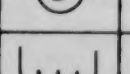
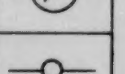
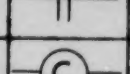
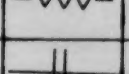
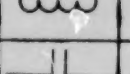
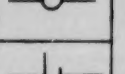
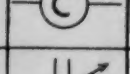
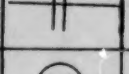
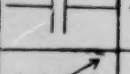
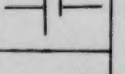
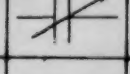
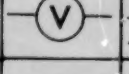
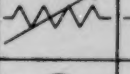
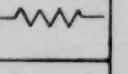
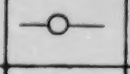
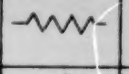
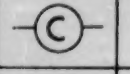
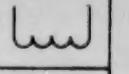
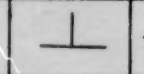
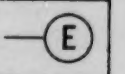
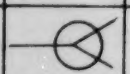
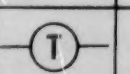
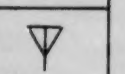
M1 - Reading a table
021022 - Reading from a grid plan
Recognising graphs from given data (in preparation)

Related skills for which tests have not been prepared:

Drawing a graph
Selection of suitable axes for graphs
Construction of labelled axes for graphs.

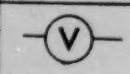
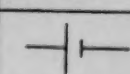
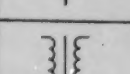
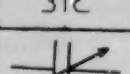
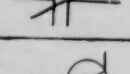
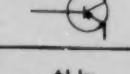
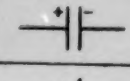
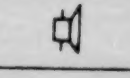
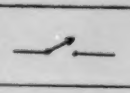
SET 1

For each of the questions, choose the symbol which matches the named electronic or electrical component. Mark its letter (A, B, C or D) on your answer sheet.

QUESTION	COMPONENT	ANSWER			
		A	B	C	D
1	Switch				
2	Cell				
3	Diode (Germanium type)				
4	Fixed resistor				
5	Capacitor				
6	Variable resistor				
7	Coil				
8	Earth				
9	Transistor				
10	Diode valve				

SET 2

For each of the questions, choose the name which matches the symbol which is shown. Mark its letter (A, B, C or D) on your answer sheet.

QUESTION	SYMBOL	ANSWERS			
		A	B	C	D
11		variable resistor	varying current	voltage source	voltmeter
12		battery	capacitor	cell	switch
13		double coil	transformer	tuned circuit	voltage supply
14		meter	rheostat	variable capacitor	variable voltage
15		thyristor	transformer	transistor	transmitter
16		electrolytic capacitor	polarised battery	polarised cell	direct current switch
17		integrated circuit	lamp	loudspeaker	transistor
18		diode	switch	variable resistor	variable voltag
19		diode	switch	variable capacitor	variable voltage
20		alternating current	ammeter	arc lamp	audion valve

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify electrical and electronic symbols.

This test has been tested on a range of students in Year 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥ 20	≥ 18	≥ 16	≥ 14	≥ 12	≥ 11	≥ 10	≥ 9	<9
		ONLY	YEAR	TEN	WAS	INVOLVED		IN	TRIALS	
10	98	2	13	23	31	52	68	76	87	13

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Lack of familiarity with the symbols used.

Related skills for which tests have not been prepared:

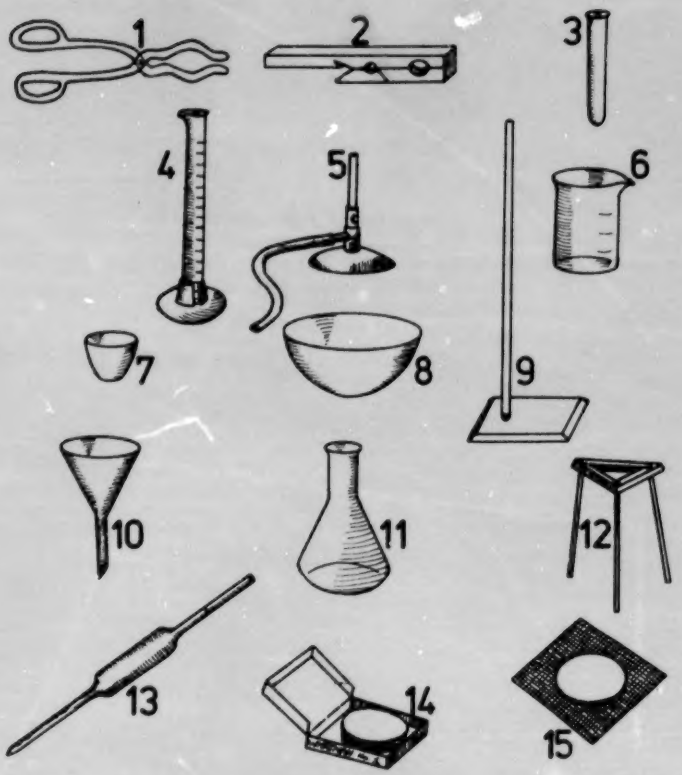
Identifying symbols in a circuit system.

Drawing circuits using these symbols.

Construct circuit from circuit diagram.

Drawing circuit diagram from a circuit.

The questions on Page 3 refer to these diagrams.



The questions below refer to the pictures of common laboratory apparatus shown opposite. These have NOT been drawn to scale. In each case, the question refers to the item with the same number. Choose the name which you think fits the item, and write its letter (A, B, C or D) on your answer sheet.

QUESTION	ANSWERS			
	A	B	C	D
1	Crucible tongs	Forceps	Test-tube holder	Tweezers
2	Crucible tongs	Forceps	Test-tube holder	Tweezers
3	Beaker	Bunsen burner	Measuring cylinder	Test tube
4	Beaker	Bunsen burner	Measuring cylinder	Test tube
5	Bunsen Burner	Measuring cylinder	Retort stand	Spirit lamp
6	Beaker	Conical flask	Gas jar	Test tube
7	Beaker	Crucible	Evaporating basin	Petri dish
8	Beaker	Crucible	Evaporating basin	Petri dish
9	Boss head	Bunsen burner	Retort stand	Tripod
10	Conical flask	Filter funnel	Measuring cone	Thistle funnel
11	Conical flask	Filter funnel	Retort	Test tube
12	Asbestos stand	Gauze	Retort stand	Tripod
13	Air blower	Burette	Measuring cylinder	Pipette
14	Filter paper	Litmus paper	Taper	Test paper
15	Asbestos mat	Filter	Gauze	Tripod

TEACHERS' NOTES

This test is designed to determine whether or not the student can name laboratory apparatus.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
7	433	23	44	65	84	92	96	98	99	1
10	283	16	39	60	78	91	95	98	99	1

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Related tests:

Identifying laboratory apparatus.(M8)

Related skills for which tests have not been prepared:

Using laboratory apparatus.

The questions below refer to the pictures of common laboratory apparatus shown opposite. These have NOT been drawn to scale. In each case, choose the item from those offered which you think matches the name. Write its letter (A, B, C or D) on your answer sheet.

QUESTION	NAME	ANSWERS			
		A	B	C	D
1	Beaker	3	6	7	8
2	Bunsen burner	3	4	5	9
3	Conical flask	4	6	10	11
4	Crucible	3	6	7	8
5	Crucible tongs	1	2	9	16
6	Evaporating basin	6	7	8	11
7	Filter funnel	10	11	13	14
8	Filter paper	10	14	15	17
9	Gauze	12	14	15	18
10	Measuring cylinder	3	4	11	13
11	Pipette	3	4	11	13
12	Retort stand	1	9	12	16
13	Test tube	3	4	6	7
14	Test tube holder	1	2	16	19
15	Tripod	12	15	16	19

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify laboratory apparatus.

This test has been tested on a range of students in Years 7 to 10 i New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arri at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
7	340	31	56	78	89	93	95	97	97	3
8	139	16	56	77	86	94	96	97	97	3

N.B. minor fluctuations may occur as a result of sampling error.

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test wi supply information about students who are having difficulty with the ski tested. For a more detailed analysis of these points, consult the manua which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific probl as indicated below:

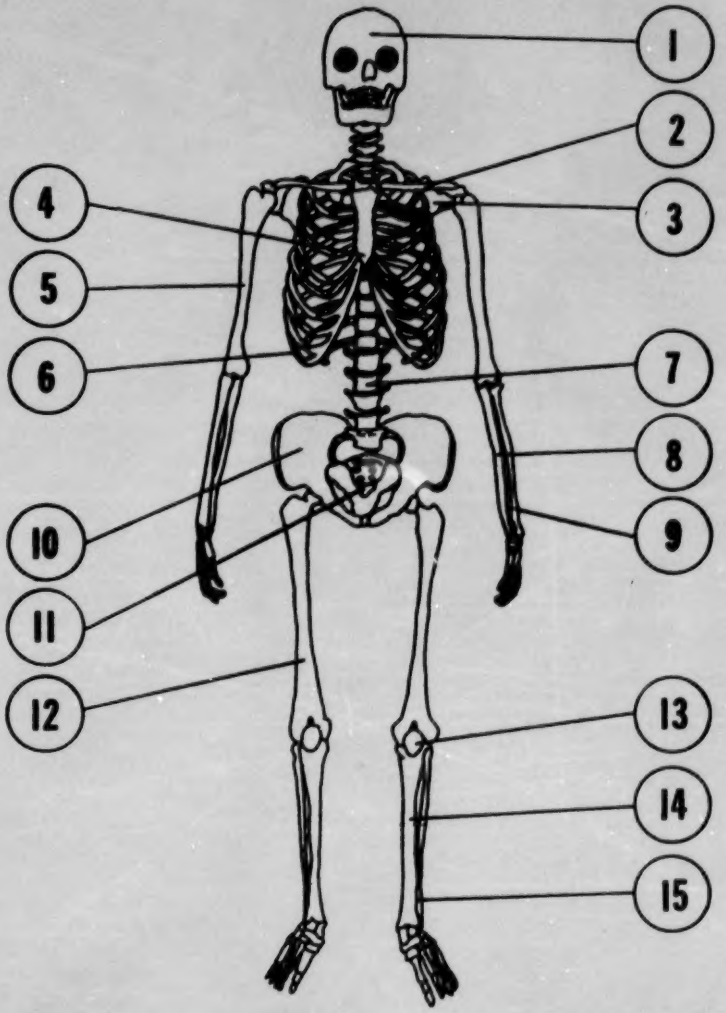
Related tests:

Naming laboratory apparatus.(M7)

Related skills for which tests have not been prepared:

Using laboratory apparatus.

The diagram on this page is to be used in answering the questions opposite.



For each of the numbered bones in the skeleton opposite, select the correct name and write its letter (A, B, C or D) on your answer sheet.

QUESTION	ANSWERS			
	A	B	C	D
1	Cerebellum	Cerebrum	Cranium	Scapula
2	Axis	Clavicle	Humerus	Scapula
3	Atlas	Clavicle	Rib	Scapula
4	Diaphragm	Rib	Sternum	Thorax
5	Biceps	Humerus	Radius	Ulna
6	Rib	Sternum	Thorax	Vertebra
7	Atlas	Coccyx	Pelvis	Vertebra
8	Carpal	Humerus	Radius	Ulna
9	Humerus	Metacarpal	Radius	Ulna
10	Coccyx	Pelvis	Phalanges	Posterium
11	Abdomen	Coccyx	Femur	Pelvis
12	Femur	Fibula	Patella	Tarsal
13	Femur	Metatarsal	Patella	Tibia
14	Fibula	Patella	Tarsal	Tibia
15	Fibula	Metatarsal	Tarsal	Tibia

TEACHERS' NOTES

This test is designed to determine whether or not the student can supply technical names for the bones of the human skeleton.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
9	62	63%	66%	89%	92%	92%	92%	92%	92%	8%
10	85	1%	1%	18%	26%	40%	52%	61%	72%	28%

N.B. Each sample consists of two classes. No control was placed on prior experience or level of ability.
In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Related tests:

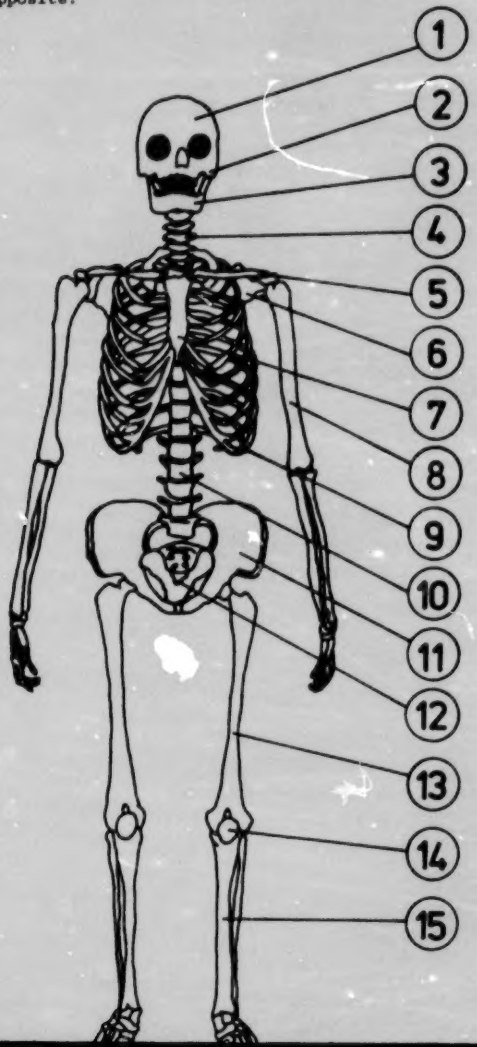
M10: Identifying bones of the human skeleton (common names).

Related skills for which tests have not been prepared:

Recognising *actual* bones.

Identifying *functions* of bones.

This test measures your ability to give the common names of bones in the human skeleton. The diagram on this page is to be used in answering the questions opposite.



For each of the numbered bones in the skeleton opposite, select the correct common name and mark its letter (A, B, C or D) on your answer sheet.

QUESTION	ANSWERS			
	A	B	C	D
1	skull	head	forehead	scalp
2	jaw bone	face bone	cheek bone	nose bone
3	chin	jaw bone	face bone	palate
4	windpipe	collar bone	tracheal bone	neck bone
5	shoulder bone	rib cage	breast plate	collar bone
6	back bone	shoulder blade	collar blade	rib bone
7	breast bone	chest bone	frontal bone	rib cage
8	upper arm bone	funny bone	shoulder bone	elbow
9	breast bone	chest bone	rib bone	spine bone
10	tail bone	spinal cord	mid bone	back bone
11	leg bone	back bone	hip bone	tail bone
12	tail bone	hip bone	rectal bone	caudal bone
13	leg bone	thigh bone	hip bone	knee bone
14	knee cap	thigh plate	ankle cap	shin plate
15	ankle bone	knee bone	hip bone	shin bone

TEACHERS' NOTES

This test is designed to determine whether or not the student can supply common names for bones of the human skeleton.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arriv at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		⩾15	⩾14	⩾13	⩾12	⩾11	⩾10	⩾9	⩾8	<8
9	252	2%	15%	36%	56%	73%	82%	91%	96%	4%
10	152	1%	12%	28%	37%	55%	70%	23%	83%	17%

N.B. Apparent inconsistencies may be attributed to small samples.

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test wil supply information about students who are having difficulty with the skil tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

A low score may indicate unfamiliarity with some of the common names used : for some students, Form A may be more relevant. For other students, a combination of the two Forms may be most effective.

Related tests:

M9 : Identifying bones of the human skeleton, Form A : technical names.

Identifying parts of the human body. (alimentary/respiratory).(M4)

Related skills for which tests have not been prepared:

Recognising *actual* bones.

Identifying *functions* of bones.

This test is designed to test your ability to give names to the different branches of Science.

SET 1

In the next five questions, statements by famous scientists are listed with four branches of science in which they may have worked. Choose the branch of Science which best fits the work described in the statement, and write its letter (A, B, C or D) on your answer sheet.

Question	Quotation	Branch of Science			
		A	B	C	D
1	Galileo Galilei: "From my observations, Jupiter has several moons."	ASTRONOMY	METEOROLOGY	GEOLOGY	PHYSICS
2	William Harvey: "My work leads men to believe that the blood flows around the body."	BIOLOGY	CHEMISTRY	GEOLOGY	PHYSICS
3	Marie Curie: "From several tonnes of pitch-blende I separated out a small amount of a new substance which I called radium."	ASTRONOMY	BIOLOGY	CHEMISTRY	GEOLOGY
4	Michael Faraday: "You can produce electricity using a magnet and a coil of wire."	ASTRONOMY	BIOLOGY	CHEMISTRY	PHYSICS
5	Antoine Lavoisier: "When we burn something, part of the air is used up."	ASTRONOMY	BIOLOGY	CHEMISTRY	PHYSICS

SET 2

In the next five questions, a scientific activity is listed with the names of four branches of science. Choose the branch which best fits the activity, and write its letter (A, B, C or D) on your answer sheet.

Question	Activity	Branches of Science			
		A	B	C	D
6	Investigating the use of solar energy.	ASTRONOMY	BIOLOGY	GEOLOGY	PHYSICS
7	Classifying animals.	BIOLOGY	CHEMISTRY	GEOLOGY	PHYSICS
8	Observing craters on a moon, from the Earth	ASTRONOMY	BIOLOGY	GEOLOGY	PHYSICS
9	Working out how mountains are made.	ASTRONOMY	BIOLOGY	CHEMISTRY	GEOLOGY
10	Separating salt from seawater.	ASTRONOMY	CHEMISTRY	GEOLOGY	PHYSICS

SET 3

In the next five questions a scientist's statement about water is listed with the names of four types of scientist. Choose the type of scientist most likely to make the statement and write the letter of your answer (A, B, C or D) on your answer sheet.

Question	Statement about water	Types of Scientist			
		A	B	C	D
11	"The rings of Saturn are made of ice and dust."	ASTRONOMER	BIOLOGIST	CHEMIST	GEOLOGIST
12	"Valleys are formed by the action of moving water."	BIOLOGIST	CHEMIST	GEOLOGIST	PHYSICIST
13	"Pure water at sea level boils at 100°C."	ASTRONOMER	BIOLOGIST	GEOLOGIST	PHYSICIST
14	"87.3% of a human body is water."	ASTRONOMER	BIOLOGIST	GEOLOGIST	PHYSICIST
15	"The formula for water is H_2O."	ASTRONOMER	BIOLOGIST	CHEMIST	PHYSICIST

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify the work carried out in the basic branches of science.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arriv at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		⩾15	⩾14	⩾13	⩾12	⩾11	⩾10	⩾9	⩾8	<8
7	143	5%	14%	23%	29%	36%	48%	67%	81%	19%
10	248	3%	29%	52%	71%	80%	87%	92%	95%	5%

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test wil supply information about students who are having difficulty with the skil tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific proble as indicated below:

Set 1 failure to recognise the type of work associated with the branches of science.

Set 2 failure to recognise the range of activities of the various branches of science.

Set 3 Inability to classify a scientific problem.

Related tests:

M15 : Scientific method.

M26 : Experimental design.

Related skills for which tests have not been prepared:

Listing activities which belong to the various branches.

Identifying ways in which the branches of science are interwoven.

Identifying the underlying themes of science.

This test measures the student's mastery of the skill of converting grams to kilograms and *vice-versa*.

SET 1

The next ten questions involve conversions from *grams* to *kilograms*. In each case, choose the correct answer from those given, and mark its letter (A, B, C or D) on your answer sheet.

Question	Mass in Grams	ANSWER IN KILOGRAMS			
		A	B	C	D
1	1	0.001	0.01	0.1	10
2	8	0.008	0.08	0.8	80
3	20	0.002	0.02	0.2	200
4	79	0.008	0.079	0.79	790
5	350	0.35	3.5	35	3 500
6	892	0.892	8.92	89.2	8 920
7	4 690	0.046	0.469	4.69	46.9
8	9 298	0.93	9.298	92.98	929.8
9	50 000	0.05	0.5	5	50
10	62 410	0.624	6.241	62.410	624.1

SET 2

The next ten questions involve conversions from *kilograms* to *grams*. In each case, choose the correct answer from those given, and mark its letter (A, B, C or D) on your answer sheet.

Question	Mass in Kilograms	ANSWER IN GRAMS			
		A	B	C	D
11	0.5	0.5	50	500	5 000
12	0.82	820	8 200	82 000	820 000
13	2.2	22	220	2 200	22 000
14	6.24	624	6 240	62 400	624 000
15	10.9	1.09	109	1 900	10 900
16	81.48	814.8	8 148	81 480	814 800
17	104	104 000	140 000	100 400	1 040 000
18	163.2	16 320	163 200	1 632 000	16 320 000
19	1 000	1	100	10 000	1 000 000
20	7 091.8	7.092	709.18	709 180	7 091 800

TEACHERS' NOTES

This test is designed to determine whether or not the student can convert grams into kilograms; and kilograms back to grams.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥20	≥18	≥16	≥15	≥14	≥13	≥12	≥11	<11
8	92	36%	70%	78%	83%	87%	89%	93%	96%	4%
10	265	42%	58%	66%	70%	72%	74%	78%	82%	18%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

For both sets - 1. students do not understand the magnitude indicated by the prefix "kilo".

2. students cannot manipulate decimal points.

Related tests:

021015 Converting metric length (trial edition)

021017 Converting metric volume (trial edition)

Related skills for which tests have not been prepared:

Estimating mass.

Determining the mass of objects.

is test is designed to test your ability to identify dangerous situations in the laboratory. For ch question, find the number which is *closest* to the hazard which is named. Find the letter which tches that number and mark the letter (A, B, C or D) on your answer sheet.

UESTION	HAZARD	ANSWERS			
		A	B	C	D
1	Someone could slip on the spilt liquid on the floor.	2	6	12	14
2	Someone could burn her hair or clothing by being too close to a lighted bunsen burner.	6	7	9	11
3	Boxes are blocking the way to a door.	8	9	10	11
4	Glassware is too close to the edge of the table and could fall and break.	5	9	11	12
5	A person could electrocute himself by using a metal screwdriver to work on a mains socket.	10	11	13	14

QUESTION	HAZARD	ANSWERS			
		A	B	C	D
6	By not watching where both hands are a person is going to burn a hand by touching a hot metal tripod.	1	5	7	11
7	Children could be injured by standing to close to a demonstration.	7	9	10	13
8	By not watching where he is going a person may knock something over or injure someone.	2	4	5	10
9	A test tube is being heated with too much liquid in it, and is aimed at a person.	6	9	11	12
10	Poisons and chemicals are kept near bottles with labels of food on them which could be taken by someone who was not careful.	1	2	10	14

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify dangerous situations in a laboratory.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arriv at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥10	≥9	≥8	≥7	≥6	≥5	≥4	≥3	<3
7	248	70%	88%	96%	98%	98%	98%	98%	99%	1%
10	145	77%	92%	100%	100%	100%	100%	100%	100%	0

In general a student achieving a score of 8 out of 10 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test wil supply information about students who are having difficulty with the skil tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific proble as indicated below:

Inability to extract information from the diagram.

Related tests:

021067 - Naming laboratory hazards (in preparation).

Free response test:

Detecting laboratory dangers.

Related skills for which tests have not been prepared:

LISTING hazards which may occur in a laboratory
PERFORMING practical work safely.

This test is designed to test your ability to calculate averages.

The following questions (1 - 15) involve finding the average of five columns of numbers. You must select the correct number from the answer columns (A, B, C or D) and write them on your answer sheet.

P	Q	R	S	T
2	8	12	20	10.0
7	6	11	42	21.0
3	9	13	65	62.5
4	5	20	83	77.7
	7	15	95	31.3
		19	73	
		15		

SET 1

What is the correct sum of each of the columns listed above?

Question	Column	ANSWERS			
		A	B	C	D
1	P	13	14	16	17
2	Q	32	33	34	35
3	R	100	105	110	115
4	S	295	358	378	388
5	T	202.5	222.5	302.5	305.5

SET 2

What number should you divide into each sum to find the average?

Question	Column	ANSWERS			
		A	B	C	D
6	P	1	2	3	4
7	Q	5	6	7	8
8	R	5	6	7	8
9	S	5	6	7	8
10	T	5	6	7	8

SET 3

What is the average of each list of numbers?

Question	Column	ANSWERS			
		A	B	C	D
11	P	1	2	3	4
12	Q	6	7	8	9
13	R	12	13	15	19
14	S	63	65	73	75
15	T	40.5	42.5	52.5	55.5

SET 4

The ages for five boys and five girls in a high school class are shown below. Use these ages to answer the questions.

BOYS: 12, 12, 12, 13, 14

GIRLS: 13, 13, 14, 14, 15

QUESTIONS	ANSWERS			
	A	B	C	D
16. The average age of the boys is:	12.0	12.6	13.0	13.6
17. The average age of the girls is:	12.8	13.0	13.8	14.5
18. The average age of both the boys and the girls is:	12.0	12.2	13.2	13.3
19. How many girls have ages that are above the average for all the children?	1	2	3	4
20. How many boys have ages that are above the average for both the girls and boys?	1	2	3	4

TEACHERS' NOTES

This test is designed to determine whether or not the student can calculate averages given a set of figures.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥20	≥19	≥18	≥17	≥16	≥15	≥14	≥13	<13
9	146	31%	39%	49%	60%	69%	73%	74%	79%	21%
10	268	51%	63%	75%	79%	83%	86%	87%	91%	9%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly unadesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problem as indicated below:

Set 1 Failure to add correctly.

Set 2 Lack of knowledge that an average is obtained by dividing by the total number of measurements given.

Set 3 Failure to use addition & division correctly in calculating the mean.

Set 4 Difficulties in handling more complex problems.

Related tests:

M1 Reading a table.

Related skills for which tests have not been prepared:

1. Basic mathematical skills.

This test is designed to test your ability to identify parts of scientific method, and the order in which they occur.

SET 1

"A boy put a plant in the soil outside his home on a cold, sunny day. He noticed that the plant drooped after a while. The boy thought that the cold and the sunshine had made the plant droop. He tested this idea by placing another plant in soil in his refrigerator overnight. In the morning, he found that the plant had drooped. He decided that the cold and the light in the refrigerator had made the plant droop. He finally stated that cold and light do make plants droop."

The next five questions require you to identify certain parts of the passage. Choose the correct name for each sentence and write its letter (A, B, C or D) on your answer sheet.

Question	Sentence	An example of			
		A	B	C	D
1	He noticed that the plant drooped after a while.	theory	experiment	hypothesis	observation
2	He finally stated that cold and light do make plants droop.	fact	conclusion	theory	experiment
3	He decided that the cold and light in the refrigerator had made the plant droop.	result	hypothesis	conclusion	experiment
4	He tested this idea by placing another one of the plants in soil in his refrigerator overnight.	experiment	hypothesis	result	theory
5	In the morning he found that the plant had drooped.	conclusion	experiment	result	theory

SET 2

For each of the following questions, select the correct answer and write its letter (A, B, C or D) on your answer sheet.

Question	Statement	ANSWERS			
		A	B	C	D
6	Experiment comes after	conclusion	hypothesis	theory	results
7	Conclusion comes before	experiment	result	theory	observation
8	Experiment is the same as	observation	test	theory	fact
9	A hypothesis accepted often grows into a	result	fact	theory	test
10	A result is part of	theory	hypothesis	observation	experiment

TEACHERS' NOTES

This test is designed to determine whether or not the student can identify and place in correct time sequence components of the scientific method.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥10	≥9	≥8	≥7	≥6	≥5	≥4	≥3	<3
7	120	1%	15%	35%	59%	72%	83%	93%	97%	3%
10	316	2%	20%	40%	64%	80%	91%	96%	100%	0%

In general a student achieving a score of 8 out of 10 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 Failure to identify components of "the scientific problems as indicated below:

Set 2 Failure to identify order of components.

Related tests:

M11 Naming the branches of science.

M26 Undertaking experimental design.

Related skills for which tests have not been prepared:

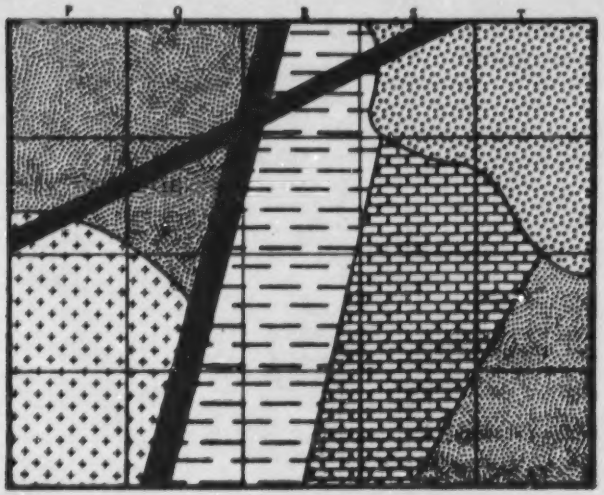
Generating hypotheses.

Designing experiments.

Making observations.

Drawing conclusions.

This test measures your ability to read and interpret a geological map. All of the questions refer to the map below:



In the next 5 questions, identify the rock which occurs in the named square. Find it in the list of possible answers and mark its letter (A, B, C or D) on your answer sheet.

Question	Square	Possible Answers			
		A	B	C	D
1	P_1	Coal	Conglomerate	Sandstone	Shale
2	P_2	Coal	Dolerite	Granite	Shale
3	S_3	Conglomerate	Limestone	Sandstone	Shale
4	T_3	Conglomerate	Dolerite	Limestone	Sandstone
5	T_4	Coal	Granite	Limestone	Sandstone

In the next 5 questions, identify the *most common* rock type in the named square and marks its letter (A, B, C or D) on your answer sheet.

Question	Square	Possible Answers			
		A	B	C	D
6	Q_2	Coal	Dolerite	Sandstone	Shale
7	Q_4	Coal	Granite	Sandstone	Shale
8	R_1	Coal	Dolerite	Sandstone	Shale
9	S_2	Conglomerate	Dolerite	Granite	Limestone
10	T_2	Conglomerate	Limestone	Sandstone	Shale

SET 3

In the next 5 questions, a rock is named, and four squares are named. Choose the ONE square in which the rock occurs and mark its letter (A, B, C or D) on your answer sheet.

Question	Rock	Possible Answers			
		A	B	C	D
11	Conglomerate	P_1	Q_1	R_1	S_1
12	Shale	Q_1	R_2	S_3	T_4
13	Sandstone	Q_2	R_4	S_2	T_2
14	Coal	Q_4	R_4	S_4	T_4
15	Dolerite	S_1	S_2	S_3	S_4

TEACHERS' NOTES

This test is designed to determine whether or not the student can read a geological map.

This test has been tested on a range of students in Years 7 to 10 i New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arri at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
8	99	70%	84%	93%	94%	96%	98%	98%	99%	1%
10	303	65%	90%	94%	96%	97%	99%	99%	99%	1%

In general a student achieving a score of out of should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test wi supply information about students who are having difficulty with the ski tested. For a more detailed analysis of these points, consult the manua which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific probl as indicated below:

All sets : Inability to use grid co-ordinates.
Inability to use key correctly.
Set 2 : Inability to estimate most common rock type in grid area

Related tests:

021022 Reading from a grid plan.
021024 Interpreting a geological map.
021023 Reading a geological map.

Related skills for which tests have not been prepared:

Drawing a geological map.
Drawing a geological cross-section from contoured geological maps.
Identification of geological structures.

This test is designed to test your ability to identify elements, compounds, and mixtures.

Set 1 Choose the substance which is an element from the alternatives in questions 1-5. Mark its letter (A,B,C or D) on your answer sheet.

QUESTION	ANSWERS			
	A	B	C	D
1	chlorine	salt	sugar	water
2	alcohol	milk	solder	tin
3	acid	iron	litmus	rust
4	air	gas	ice	oxygen
5	cotton	solder	sulphur	wool

Set 2 Choose the substance which is a mixture from the alternatives in questions 6-10. Mark its letter (A,B,C or D) on your answer sheet.

QUESTION	ANSWERS			
	A	B	C	D
6	air	lead	salt	water
7	water	milk	tin	zinc
8	aluminium	iron	soil	sugar
9	lead	solder	tin	zinc
10	cellulose	blood	gelatin	graphite

Set 3 Choose the substance which is a compound from the alternatives in questions 11-15. Mark its letter (A,B,C or D) on your answer sheet.

QUESTION	ANSWERS			
	A	B	C	D
11	air	lead	rust	tin
12	iron	milk	salt	sulphur
13	coffee	hydrogen	milk	sugar
14	ice	sulphur	silver	tin
15	chlorine	milk	tea	starch

Set 4 Choose the correct classification for each substance from the alternatives given in questions 16-20. Mark its letter (A,B or C) on your answer sheet.

QUESTION	SUBSTANCE	ANSWERS		
		A	B	C
16	Nitrogen	compound	element	mixture
17	Petrol	compound	element	mixture
18	Quartz	compound	element	mixture
19	Rust	compound	element	mixture
20	Saliva	compound	element	mixture

TEACHERS' NOTES

This test is designed to determine whether or not the students know the differences between elements, mixtures and compounds and can distinguish between common elements, mixtures and compounds.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥ 20	≥ 18	≥16	≥ 14	≥ 12	≥10	≥9	≥ 8	<8
9	79	4%	13%	15%	18%	32%	44%	62%	70%	30%
10	282	3%	11%	21%	34%	46%	62%	71%	78%	22%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 Lack of familiarity with the substances named.
Failure to understand what is meant by *element*.

Set 2 Lack of familiarity with the substances named.
Failure to understand what is meant by *mixture*.

Set 3 Lack of familiarity with the substances named.
Failure to understand what is meant by *compound*.

Set 4 Lack of familiarity with the substances named.
Failure to understand what is meant by *element*, *compound* or *mixture*.

Related skills for which tests have not been prepared:

Recognising elements, compounds and mixtures using laboratory techniques

Isolating elements and compounds from mixtures.

This test measures your ability to carry out calculations involving Ohm's Law.

OHM'S LAW

P.D. = I x R

WHERE P.D. = POTENTIAL DIFFERENCE (IN VOLTS)

I = CURRENT (IN AMPERES)

R = RESISTANCE (IN OHMS)

For each question, choose the alternative which belongs in the gap in the table. Mark its letter (A, B, C or D) on your answer sheet.

Question	Table			A	B	C	D
	Potential Diff. (in volts)	Current (in amps)	Resistance (in ohms)				
1		0.1	0.1	0.01	0.1	1	10
2		1	0.5	0.05	0.5	1	2
3		1	2	0.5	1	2	3
4		2	5	0.4	2.5	7	10
5		5	1	0.2	5	6	10
6	10	1		0.1	1	10	11
7	10	10		1	10	20	100
8	2	5		0.4	2.5	7	10
9	100	5		0.05	0.5	20	500
10	250	25		0.1	10	275	6250
11	10		10	0	1	20	100
12	5		1	0.2	4	5	6
13	20		50	0.4	2.5	70	1000
14	100		1000	0.1	10	1100	100000
15	250		100	0.04	1	2.5	25000

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SET 4

This set is designed to identify problems which you may have shown in the first three sets. In each question, use the equation given for that question to find the correct answer, and mark its letter (A, B, C or D) on your answer sheet.

Question	Given Equation	Find	ANSWERS			
			A	B	C	D
16	$x = 2y$	y	2x	x	$\frac{x}{2}$	x^2
17	$y = \frac{x}{z}$	x	yz	$\frac{z}{y}$	$\frac{y}{z}$	y + z
18	$y = \frac{x}{z}$	z	$\frac{x}{y}$	$\frac{y}{z}$	xy	x + y
19	$x = yz$	y	$\frac{z}{x}$	$\frac{x}{z}$	xz	x + z
20	$x = yz$	z	$\frac{x}{y}$	$\frac{y}{x}$	xy	x + y

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TEACHERS' NOTES

This test is designed to determine whether or not the student can carry out calculations involving Ohm's Law.

This test has been tested on a range of students in Year 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must li with the classroom teacher. The information below will help you to arr at an informed decision. In this table you will find the percentages o students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥15	≥ 14	≥13	≥12	≥ 11	≥ 10	≥9	≥ 8	<8
	ONLY	YEAR	TEN	WAS	INVOLVED	IN	TRIALS			
10	364	9%	19%	26%	32%	51%	64%	77%	85%	15

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use fo this purpose is highly undesirable. The scores obtained on this test w supply information about students who are having difficulty with the sk tested. For a more detailed analysis of these points, consult the manu which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific prob as indicated below:

Set 1 Failure to substitute and multiply correctly.

Set 2 Failure to manipulate equation correctly (see 021064)
Failure to substitute and divide correctly.

Set 3 Failure to manipulate equation correctly (see 021064)
Failure to substitute and divide correctly.

Set 4 These items are intended to identify particular difficulties in equation manipulation.

Related tests:

021058 Using F = ma

021064 Manipulating equations.

Related skills for which tests have not been prepared:

Using: $P.E. = mgh$ Wiring circuits

$K.E. = \frac{1}{2}mv^2$ Reading meters

$W = Fs$

$S = \frac{D}{T}$

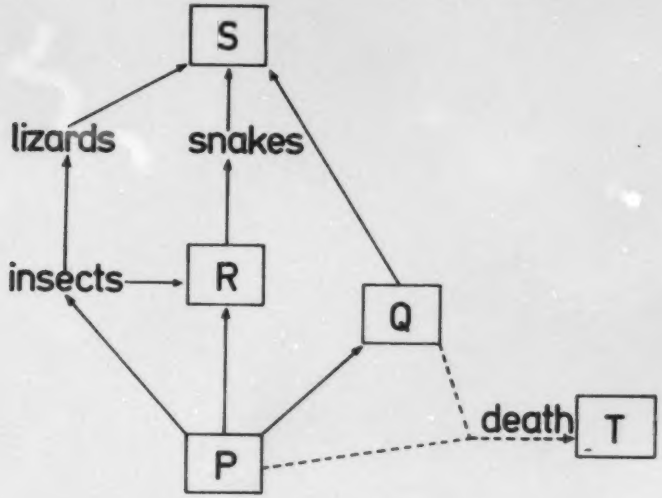
$V = u + at$ etc.

This test is designed to test your ability to interpret diagrams of food chains, food webs, and food pyramids, and to identify missing links in incomplete diagrams.

Set 1 In the next five questions, an incomplete food chain is shown. In each question, choose the alternative which best fits the gap in the food chain. Mark its letter (A,B,C or D) on your answer sheet.

QUESTION	INCOMPLETE FOOD CHAIN	ANSWERS			
		A	B	C	D
1	grass→?→snake→bird	flower	grasshopper	horse	cat
2	?→caterpillar→frog→cat	dingo	butterfly	leaf	spider
3	flower→bee→spider→?	mosquito	fern	grasshopper	bird
4	seaweed→black-fish→king-fish→?	shark	octopus	crab	lobster
5	?→water snail→gold-fish→bird	algae	worm	rock	water snake

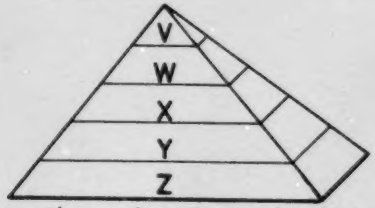
Set 2 The next five questions refer to this food web diagram.



Choose the name which fits best in the space on the diagram and mark its letter on your answer sheet.

QUESTION	LETTER ON DIAGRAM	ANSWERS			
		A	B	C	D
6	P	herbivore	scavenger	producer	carnivore
7	Q	herbivore	producer	omnivore	carnivore
8	R	producer	omnivore	carnivore	scavenger
9	S	omnivore	herbivore	carnivore	scavenger
10	T	producer	herbivore	carnivore	scavenger

Set 3 The next five questions refer to this food pyramid diagram



For each of the questions, select the organism which best fits the statement, and mark its letter (A,B,C or D) on your answer sheet.

QUESTION	QUESTIONS BASED ON DIAGRAMS	ANSWERS			
		A	B	C	D
11	The producer in the pyramid is	V	X	Y	Z
12	The herbivore in the pyramid is	V	X	Y	Z
13	The animal with the smallest number in the community is	V	W	X	Y
14	The living thing that has the largest numbers in the community is	V	W	Y	Z
15	The first carnivore is	W	X	Y	Z

TEACHERS' NOTES

This test is designed to determine whether or not the student understands the concepts involved in food chains, webs and pyramids and can correctly follow through a food chain, web and pyramid.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
8	60	20%	33%	64%	79%	85%	90%	93%	97%	3%
10	409	18%	29%	39%	50%	59%	68%	77%	84%	16%

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 Incorrect interpretation of arrows.
Unfamiliarity with organisms used in questions.

Set 2 Unfamiliarity with conventions used in diagram.
Unfamiliarity with terms used in options.

Set 3 Unfamiliarity with conventions used in diagram.
Unfamiliarity with terms used in options.

Related skills for which tests have not been prepared:

Drawing food chain, web, and pyramid diagrams.

Identifying members of real food chains, webs and pyramids.

YOU WILL NEED A PROTRACTOR TO ANSWER THIS TEST.

This test is designed to measure your ability to measure angles of incidence, reflection and refraction. For each of the next fifteen questions, measure the angle asked for, and find the letter which matches the correct value. Mark the letter (A, B, C or D) on your answer sheet.

Set 1

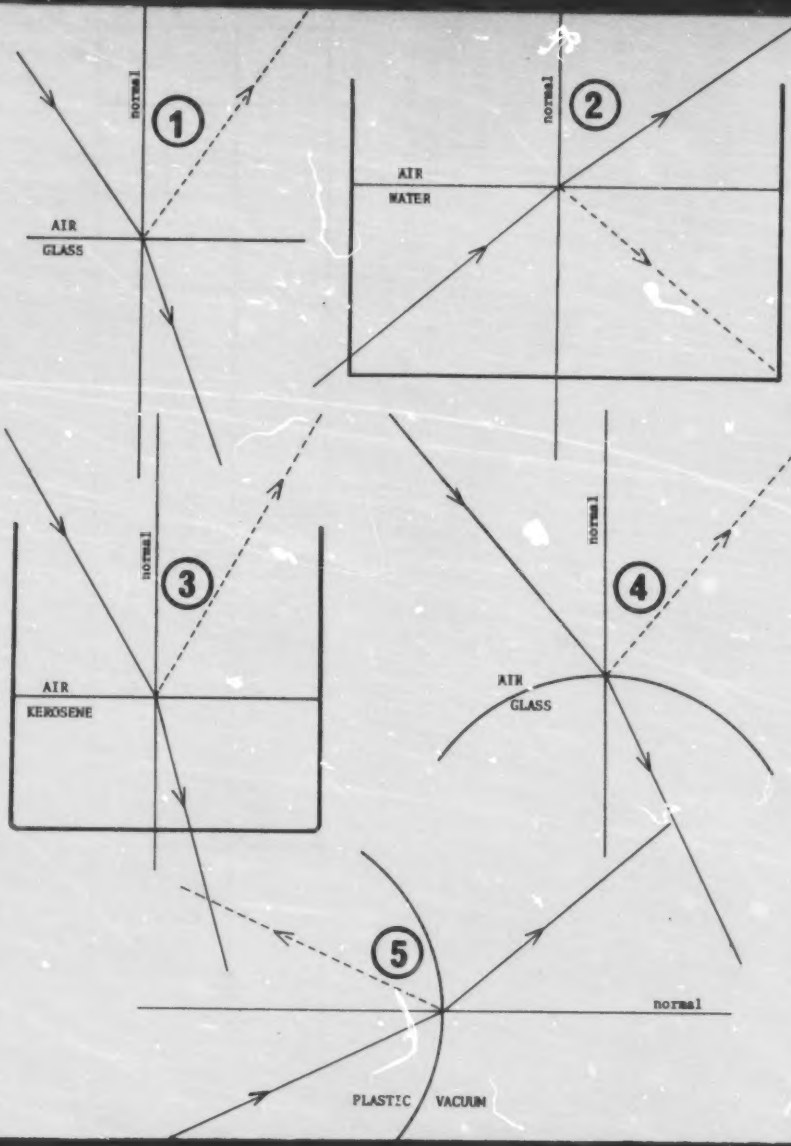
QUESTION	ANGLE INCIDENCE FOR	A	B	C	D
1	Diagram 1 is	20	35	55	70
2	Diagram 2 is	45	50	55	60
3	Diagram 3 is	24	26	28	30
4	Diagram 4 is	40	50	80	110
5	Diagram 5 is	18	20	25	50

Set 2

QUESTION	ANGLE REFLECTION FOR	A	B	C	D
6	Diagram 1 is	30	35	55	60
7	Diagram 2 is	40	45	50	55
8	Diagram 3 is	30	40	50	60
9	Diagram 4 is	30	35	40	80
10	Diagram 5 is	20	25	28	45

Set 3

QUESTION	ANGLE REFRACTION FOR	A	B	C	D
11	Diagram 1 is	20	35	55	70
12	Diagram 2 is	25	45	55	75
13	Diagram 3 is	15	75	125	132
14	Diagram 4 is	25	40	60	80
15	Diagram 5 is	20	30	35	40



TEACHERS' NOTES

This test is designed to determine whether or not the student can identify and measure angles of incidences, refraction and reflection.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥15	≥14	≥13	≥12	≥11	≥10	≥9	≥8	<8
9	135	15%	22%	30%	38%	47%	58%	65%	70%	30%
10	252	8%	18%	26%	35%	45%	58%	66%	77%	23%

In general a student achieving a score of 12 out of 15 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 Misunderstanding of meaning of "angle of incidence". Incorrect use of protractor.

Set 2 Misunderstanding of meaning of "angle of reflection". Incorrect use of protractor.

Set 3 Misunderstanding of meaning of "angle of refraction". Incorrect use of protractor.

Related tests:

021052 Recognising angles of incidence, reflection and refraction (trial edition)

Related skills for which tests have not been prepared:

Plotting angles of incidence, reflection and refraction in real life.

Using a protractor.

This test is designed to measure your ability to calculate the kinetic energy of moving bodies using the equation

$$KE = \tfrac{1}{2}MV^2$$

where KE is the kinetic energy in joules,
M is the mass in kilograms
and V is the velocity in metres per second.

SET 1

In each of the next five questions, you are given the mass and the velocity of a moving body. Choose the correct kinetic energy from the alternatives given, and mark its letter (A, B, C or D) on your answer sheet.

Question	Mass kg	Velocity m/s	KINETIC ENERGY IN JOULES			
			A	B	C	D
1	1	2	1	2	3	4
2	2	1	1	2	3	4
3	4	20	80	320	400	800
4	5	10	50	100	250	500
5	10	5	50	100	125	250

SET 2

Choose the object with the *greatest* kinetic energy from the alternatives given. Mark the letter (A, B, C or D) of your choice on your answer sheet.

Question	OBJECT A		OBJECT B		OBJECT C		OBJECT D	
	Mass	Vel.	Mass	Vel.	Mass	Vel.	Mass	Vel.
6	1	5	2	3	4	2	5	1
7	1	4	2	3	4	2	5	1
8	1	3	3	1	2	2	2	3
9	10	20	20	10	50	5	5	30
10	10	1	2	5	1	10	[illegible]	2

SET 3

In each of the next ten questions, changes to a moving body are named. Work out what the change will be to the kinetic energy. Find the letter (A, B, C or D) which matches your answer and mark it on your answer sheet.

Question	CHANGE(S)	A	B	C	D
11	mass is halved	$\times\frac{1}{2}$	$\times 2$	$\times\frac{1}{4}$	$\times 4$
12	mass is doubled	$\times\frac{1}{2}$	$\times 2$	$\times\frac{1}{4}$	$\times 4$
13	velocity is halved	$\times\frac{1}{2}$	$\times 2$	$\times\frac{1}{4}$	$\times 4$
14	velocity is doubled	$\times\frac{1}{2}$	$\times 2$	$\times\frac{1}{4}$	$\times 4$
15	mass and velocity halved	$\times\frac{1}{2}$	$\times\frac{1}{4}$	$\times 1/8$	$\times 1/16$
16	mass and velocity doubled	$\times 2$	$\times 4$	$\times 6$	$\times 8$
17	mass halved and velocity doubled	$\times\frac{1}{2}$	$\times 1$	$\times 2$	$\times 4$
18	mass doubled and velocity halved	$\times\frac{1}{2}$	$\times 1$	$\times 2$	$\times 4$
19	mass tripled	$\times 1/3$	$\times 3$	$\times 6$	$\times 9$
20	velocity tripled	$\times 1/9$	$\times 1/3$	$\times 6$	$\times 9$

TEACHERS' NOTES

This test is designed to determine whether or not the student can calculate kinetic energy using the equation $KE = \frac{1}{2}MV^2$

This test has been tested on a range of students in Years 10 New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥ 20	≥ 18	≥ 16	≥ 14	≥ 12	≥ 10	≥ 8	≥ 6	< 6
		ONLY	YEAR	TEN	WAS	INVOLVED		IN	TRIALS	
10	453	15%	28%	38%	53%	67%	79%	88%	94%	6%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

In Set 3, some students may encounter problems with "halved", "doubled" "tripled", or the use of "x½", "x2" etc.

In Sets 1 and 2 students may make arithmetic erros such as forgetting to use v^2, or using $(mv)^2$.

Related Tests

M18	Using Ohm's Law
M22	Using F = ma
M25	Manipulating questions

Related skills for which tests have not been prepared:

Performing arithmetical calculations.
Measuring kinetic energy.

This test is designed to measure your ability to make calculations using the "Newton's Law" equation

$$F = ma$$

where F = a force in newtons
m = a mass in kilograms
a = an acceleration in metres per second^2

In each question, choose the alternative which will complete the table. Mark its letter (A, B, C or D) on your answer sheet.

Question	Table: Force (in newtons)	Table: Mass (in kilograms)	Table: Acceleration (in metres per second^2)	A	B	C	D
SET 1							
1	0.1	0.1		0.01	0.1	1	10
2	1	1		0.1	1	2	10
3	1	10		0.1	1	10	20
4	10	1		10	11	100	1 000
5	10	10		0.1	1	10	100
SET 2							
6	0.1		1	0.01	0.1	1	10
7	1		1	1	2	10	100
8	10		10	0.01	0.1	1	10
9	100		10	0.01	0.1	1	10
10	10		100	0.1	1	10	1 000
SET 3							
11		0.1	0.1	0.01	0.1	1	10
12		0.1	1	0.001	0.01	0.1	1
13		1	10	0.01	0.1	1	10
14		10	1	0.01	0.1	1	10
15		10	10	0.1	1	100	1 000

SET 4

This set is designed to identify problems which you may have shown in the first three sets. In each question, use the equation given for that question to find the correct answer, and mark its letter (A, B, C or D) on your answer sheet.

Question	Given Equation	Find	ANSWERS: A	B	C	D
16	$x = 2y$	y	$2x$	x	$\frac{x}{y}$	x^2
17	$y = \frac{x}{z}$	x	yz	$\frac{z}{y}$	$\frac{y}{z}$	$y + z$
18	$y = \frac{x}{z}$	z	$\frac{x}{y}$	$\frac{y}{x}$	xy	$x + y$
19	$x = yz$	y	$\frac{z}{x}$	$\frac{x}{z}$	xz	$x + z$
20	$x = yz$	z	$\frac{x}{y}$	$\frac{y}{x}$	xy	$x + y$

TEACHERS' NOTES

This test is designed to determine whether or not the student can make calculations using the equation F = ma.

This test has been tested on a range of students in Year 10 New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥20	≥19	≥18	≥17	≥16	≥15	≥14	≥13	<13
		ONLY	YEAR	TEN	WAS	INVOLVED	IN	TRIALS		
10	481	29%	47%	58%	65%	73%	75%	79%	80%	20%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 Failure to manipulate equation correctly.

Set 2 Failure to manipulate equation correctly.

Set 3 Failure to manipulate equation correctly.

Set 4 These items are intended to identify particular difficulties in equation manipulation.

Related tests:

021046 Using Ohm's Law.

021064 Manipulating equations.
Calculating kinetic energy.

Related skills for which tests have not been prepared:

Division and multiplication with decimal numbers.

Calculating momentum.

This test is designed to test your ability to use the table of geological periods set out below.

Era	Period	Epoch	Length (millions of years)	Time from beginning to present (millions of years)
Cainozoic	Quaternary	Recent		
		Pleistocene	3	3
	Tertiary	Pliocene	9	12
		Miocene	13	25
		Oligocene	15	40
		Eocene	20	60
		Paleocene	10	70
Mesozoic	Cretaceous		65	135
	Jurassic		45	180
	Triassic		45	225
Palaeozoic	Permian		45	270
	Carboniferous		80	350
	Devonian		50	400
	Silurian		40	440
	Ordovician		60	500
	Cambrian		100	600
Precambrian			3 900	4 500

SET 1

In the next ten questions, a geological period is named, use the table to find the geological era in which it occurred and mark its letter (A, B, C or D) on your answer sheet.

Question	Period	A	B	C	D
1.	Cambrian	Cainozoic	Mesozoic	Palaeozoic	Precambrian
2.	Carboniferous	Cainozoic	Mesozoic	Palaeozoic	Precambrian
3.	Cretaceous	Cainozoic	Mesozoic	Palaeozoic	Precambrian
4.	Devonian	Cainozoic	Mesozoic	Palaeozoic	Precambrian
5.	Jurassic	Cainozoic	Mesozoic	Palaeozoic	Precambrian
6.	Ordovician	Cainozoic	Mesozoic	Palaeozoic	Precambrian
7.	Permian	Cainozoic	Mesozoic	Palaeozoic	Precambrian
8.	Quaternary	Cainozoic	Mesozoic	Palaeozoic	Precambrian
9.	Silurian	Cainozoic	Mesozoic	Palaeozoic	Precambrian
10.	Tertiary	Cainozoic	Mesozoic	Palaeozoic	Precambrian

SET 2

In the next five questions, a geological period is named. Use the table to find how long the period lasted. Find the letter (A, B, C or D) which matches your answer and mark it on your answer sheet.

Question		Answer in Millions of Years			
		A	B	C	D
11	Ordovician	60	440	500	560
12	Quaternary	0	3	6	9
13	Tertiary	9	12	67	70
14	Cretaceous	65	70	135	200
15	Cambrian	100	500	600	700

SET 3

In the next five questions, a geological period is named. Use the table to choose the correct description of when the period occurred. Mark its letter (A, B, C or D) on your answer sheet.

Question	Period	A	B	C	D
16	Devonian	before Permian before Cambrian	after Permian before Cambrian	before Permian after Cambrian	after Permian after Cambrian
17	Carboniferous	before Triassic before Permian	after Triassic before Permian	before Triassic after Permian	after Triassic after Permian
18	Cretaceous	before Jurassic before Devonian	before Jurassic after Devonian	after Jurassic before Devonian	after Jurassic after Devonian
19	Silurian	before Cretaceous before Cambrian	before Cretaceous after Cambrian	after Cretaceous before Cambrian	after Cretaceous after Cambrian
20	Ordovician	before Tertiary before Silurian	after Tertiary before Silurian	before Tertiary after Silurian	after Tertiary after Silurian

TEACHERS' NOTES

This test is designed to determine whether or not the student can use a table of geological periods.

This test has been tested on a range of students in Year 10 New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arriv at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	S C O R E								
		≥20	≥18	≥16	≥14	≥13	≥12	≥11	≥10	<10
		ONLY	YEAR	TEN	WAS	INVOLVED		IN	TRIALS	
10	424	14%	36%	41%	78%	86%	89%	94%	97%	3%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problem as indicated below:

Set 1 this set is aimed at the ability to extract basic information from a table. See also test 021001.

Set 2 this set is aimed at the ability to extract more complex information from a table.

Set 3 this set is carried over in a slightly revised form from test 021005. About 40% of average Year 10 students could be expected to answer each of these items.

Related tests:

021005 is replaced by this test.

Related skills for which tests have not been prepared:

Constructing a table of geological periods from raw data.

TEACHERS' NOTES

This test is designed to determine whether or not the student can use scientific notation.

This test has been tested on a range of students in Year 10 in New South Wales schools. It is harder than most mastery tests.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur. Some of the skills required are only taught by Mathematics teachers to Advanced level students.

YEAR	NO. OF STUDENTS	S C O R E								
		≥ 20	≥ 18	≥ 16	≥ 14	≥ 12	≥ 10	≥ 8	≥ 6	< 6
			ONLY	YEAR	10	WAS	INVOLVED	IN	TRIALS	
10	223	2%	6%	13%	26%	36%	45%	61%	75%	25%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 - Difficulty in manipulating figures in scientific notation. Lack of familiarity with metric system.

Set 2 - Difficulty in manipulating figures in scientific notation. Lack of familiarity with metric system.

Set 3 - Difficulty in manipulating figures in scientific notation. Lack of familiarity with metric system.

Set 4 - Difficulty in manipulating figures in scientific notation. Lack of familiarity with metric system.

Related tests:

021015 - Converting metric length
021061 - Using scientific notation part 1
021064 - Dividing in scientific notation
Converting metric volume
Converting metric mass

The questions in this test are designed to test your ability to manipulate or rearrange equations that occur in science.

In the next 20 questions, equations are listed with four possible ways of rearranging each equation. Choose the correct rearrangement of the equation and mark its letter (A,B,C, or D) on your answer sheet.

QUESTION	EQUATION	REARRANGEMENT			
		A	B	C	D
1	$x = yz$	$z = xy$	$z = \frac{y}{x}$	$z = \frac{x}{y}$	$z = x + y$
2	$x = yz$	$y = \frac{z}{x}$	$y = xz$	$y = \frac{x}{z}$	$y = x + z$
3	$F = ma$	$a = Fm$	$a = F + m$	$a = \frac{m}{F}$	$a = \frac{F}{m}$
4	$F = ma$	$m = Fa$	$m = \frac{F}{a}$	$m = a + F$	$m = \frac{a}{F}$
5	$x = \frac{y}{z}$	$y = \frac{x}{z}$	$y = \frac{z}{x}$	$y = xz$	$y = x + z$
6	$x = \frac{y}{z}$	$z = xy$	$z = \frac{x}{y}$	$z = x + y$	$z = \frac{y}{x}$
7	$P = \frac{W}{t}$	$W = Pt$	$W = \frac{P}{t}$	$W = \frac{t}{P}$	$W = P + t$
8	$P = \frac{W}{t}$	$t = PW$	$t = \frac{W}{P}$	$t = P + W$	$t = \frac{P}{W}$
9	$x = y + az$	$y = x + az$	$y = az - x$	$y = x - az$	$y = az + x$
10	$x = y + az$	$z = \frac{x + y}{a}$	$z = \frac{y}{a} + \frac{x}{a}$	$z = \frac{x - y}{a}$	$z = x + ay$
11	$x = y + az$	$a = xz + y$	$a = \frac{x}{z} + \frac{y}{z}$	$a = \frac{y}{z} + x$	$a = \frac{x - y}{z}$
12	$v = u + at$	$u = v - at$	$u = v + at$	$u = a + vt$	$u = av + t$
13	$v = u + at$	$a = \frac{v + u}{t}$	$a = \frac{v - u}{t}$	$a = \frac{u - v}{t}$	$a = u + vt$
14	$v = u + at$	$t = v + au$	$t = v - ua$	$t = \frac{v}{a} + \frac{u}{a}$	$t = \frac{v - u}{a}$
15	$x = \frac{1}{2} yz^2$	$y = \frac{2x}{z^2}$	$y = \frac{z^2}{2x}$	$y = \frac{x}{2z^2}$	$y = \frac{2z^2}{x}$

QUESTION	EQUATION	REARRANGEMENT			
		A	B	C	D
16	$x = \frac{1}{2} yz^2$	$z^2 = \frac{y}{2x}$	$z^2 = \frac{2x}{y}$	$z^2 = \frac{2y}{x}$	$z^2 = \frac{x}{2y}$
17	$K = \frac{1}{2} mv^2$	$v^2 = \frac{K}{2m}$	$v^2 = \frac{2m}{K}$	$v^2 = \frac{2K}{m}$	$v^2 = \frac{m}{2K}$
18	$K = \frac{1}{2} mv^2$	$m = \frac{2v^2}{K}$	$m = \frac{K}{2v^2}$	$m = \frac{v^2}{2K}$	$m = \frac{2K}{v^2}$
19	$g = \frac{S}{2t^2}$	$S = 2gt^2$	$S = \frac{2g}{t^2}$	$S = \frac{t^2}{2g}$	$S = \frac{2t^2}{g}$
20	$g = \frac{S}{2t^2}$	$t^2 = \frac{2S}{g}$	$t^2 = \frac{g}{2S}$	$t^2 = \frac{2g}{S}$	$t^2 = \frac{S}{2g}$

TEACHERS' NOTES

This test is designed to determine whether or not the student can manipulate or rearrange equations.

This test has been tested on a range of students in Year 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥ 20	≥ 18	≥16	≥14	≥ 12	≥10	≥8	≥ 6	<6
		ONLY	YEAR	TEN	WAS	INVOLVED	IN	TRIALS		
10	480	14%	19%	38%	51%	63%	75%	86%	93%	7%

In general a student achieving a score of 16 out of 20 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Difficulties in manipulating equations.

This test is designed to identify specific problems which may affect performance on other mastery tests. It will be noted that "x, y, z" equations are mixed in with common scientific formulae which have the same form of expression.

A student who has mastered this skill could be expected to perform well in

M18 Using Ohm's Law
M21 Calculati[illegible]inetic energy
M22 Using F

Related tests:

021061 Using scientific notation 1
M24 Using scientific notation 2
021065 Dividing in scientific notation

Related skills for which tests have not been prepared:

Basic skills in arithmetic.

TEACHERS' NOTES

This test is designed to determine whether or not the student can analyse an experimental design.

This test has been tested on a range of students in Year 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher. The information below will help you to arrive at an informed decision. In this table you will find the percentages of students achieving a given score *or better*. Cumulative percentages are given for the two years in which the longest samples occur.

YEAR	NO. OF STUDENTS	SCORE								
		≥ 10	≥ 9	≥ 8	≥ 7	≥ 6	≥ 5	≥ 4	≥ 3	<3
		ONLY	YEAR	10	WAS	INVOLVED	IN	TRIALS		
10	431	2%	10%	31%	50%	71%	84%	93%	97%	3%

In general a student achieving a score of 8 out of 10 should be regarded as having mastered this skill.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Questions 1, 2, 3, 7, 8 - ability to design experimental procedure, in particular, method.

Questions 4, 9 - ability to state results of experiment.

Questions 5, 10 - ability to draw conclusions from experiments.

Question 6 - ability to recognise the hypothesis.

Related tests:

M15 - Identifying parts of the scientific method.

Related skills for which tests have not been prepared:

Designing experiments in different scientific areas.
Selecting suitable apparatus.
Performing experiments.

This test is designed to test your ability to use scientific notation in a practical situation.

SET 1

For each question, a measurement is given in kilometres, together with four possible equivalents in metres. Choose the correct answer for each question and mark its letter (A, B, C or D) on your answer sheet.

Question	Measurement in kilometres	Possible answers expressed in metres			
		A	B	C	D
1	2	2×10^0	2×10^1	2×10^2	2×10^3
2	40	4×10^2	4×10^4	4×10^6	4×10^8
3	3.5	3.5×10^1	3.5×10^2	3.5×10^3	3.5×10^4
4	500	5×10^3	5×10^4	5×10^5	5×10^6
5	.1	1×10^0	1×10^1	1×10^2	1×10^3

SET 2

For each question, a measurement is given in kilometres, together with four possible equivalents in metres. Choose the correct answer for each question and mark its letter (A, B, C or D) on your answer sheet.

Question	Measurement in kilometres	Possible answers in metres			
		A	B	C	D
6	2×10^1	200	2 000	20 000	200 000
7	2.5×10^2	2 500	25 000	250 000	2 500 000
8	3×10^5	300	3 000	30 000	300 000
9	1.1×10^3	1 100	110 000	1 100 000	11 000 000
10	2.7×10^1	2 700	27 000	270 000	2 700 000

SET 3

For each question, a measurement is given in metres, together with four possible equivalents in kilometres. Choose the correct answer for each question and mark its letter (A, B, C or D) on your answer sheet.

Question	Measurement in metres	Possible answer given in kilometres			
		A	B	C	D
11	5 000	5×10^0	5×10^1	5×10^2	5×10^3
12	400	4×10^0	4×10^{-1}	4×10^{-2}	4×10^{-3}
13	35 000	3.5×10^0	3.5×10^1	3.5×10^2	3.5×10^3
14	6	6×10^0	6×10^{-1}	6×10^{-2}	6×10^{-3}
15	67	6.7×10^0	6.7×10^{-1}	6.7×10^{-2}	6.7×10^{-3}

SET 4

For each question, a measurement is given in metres, together with four possible equivalents in kilometres. Choose the correct answer for each question and mark its letter (A, B, C or D) on your answer sheet.

Question	Measurement in metres	Possible answer given in kilometres			
		A	B	C	D
16	3×10^2	0.3	3	30	300
17	6.6×10^4	0.66	6.6	66	660
18	1×10^3	0.1	1	10	100
19	4.5×10^1	0.045	0.45	4.5	45
20	8.6×10^3	0.86	8.6	86	860

This test is designed to measure your ability to analyse a design for an experiment.

Set 1 A student saw a T.V. advertisement for a new washing powder "Gusho". The advertisement claimed the Gusho gets whites "whiter" in cold water than brand X does in cold water. Two students decided to test this claim by carrying out an experiment. They took 3 sheets and washed them in a washing machine as follows:

(i) sheet 1 in cold water and brand 'X'
(ii) sheet 2 in cold water and Gusho
(iii) sheet 3 in cold water only

After drying and comparing the sheets they found that there was no difference in the whiteness of the 3 sheets.

For each of the next five questions, choose the *best* answer and mark its letter (A, B, C or D) on your answer sheet.

QUESTION	STATEMENT	POSSIBLE ANSWERS			
		A	B	C	D
1	The control(s) is (are):-	wash (i)	wash (ii)	wash (iii)	wash (i) & (ii)
2	The experiment could be improved by:-	using more Gusho	carrying out experiment in hot & cold water	doing the experiment three times	using the same sheet in each wash
3	In the 3 washes one thing that would NOT have to be controlled is:-	the amount of soap powder used	the size of the washing machine	the amount of water	the time of each wash
4	The experiment shows that:-	Gusho washes better	brand "X" washes better	Gusho & brand "X" wash equally well	Gusho, brand "X" & water wash just as well as each other
5	From this experiment the students could conclude that the claim was:-	true	partly true	not supported	false

Set 2 Some students read in a book that boys can run faster than girls. They asked some of their friends to race against each other on the school oval during their lunchtime. The results were:-

(i) Jill beat Tom over 100 metres
(ii) Rod beat Sally over 200 metres
(iii) Ruth beat Bill over 400 metres

The students decided that their results showed that the statement in the book was wrong.

For each of the next five questions, choose the *best* answer and mark its letter (A, B, C or D) on your answer sheet.

QUESTION	STATEMENT	POSSIBLE ANSWERS			
		A	B	C	D
6	The statement in the book is clear about	the ages of the boys & girls	the distances to be run	how many students were tested	which sex runs faster
7	Which factor does not need to be controlled?	distances run	prior training	age & size of competitors	number of races held
8	The experiment would be improved by:-	checking the statement by reading other books	have more competitors in each race	race boys against boys, girls against girls	conducting a survey of student opinion
9	The experiment's results show us that:-	girls always beat boys	girls do more training than boys	boys sometimes beat girls	Ruth is the fastest runner
10	From the results of this experiment, the students could conclude that the statement in the book:-	probably false	definitely false	probably true	definitely true